Complete Program/12th Annual National Conference on Industrial Hydraulics

APPLIED HYDRAULICS

OCTOBER 1956

GAZINE OF FLUID POWER : Air Circuits — Electrical Controls

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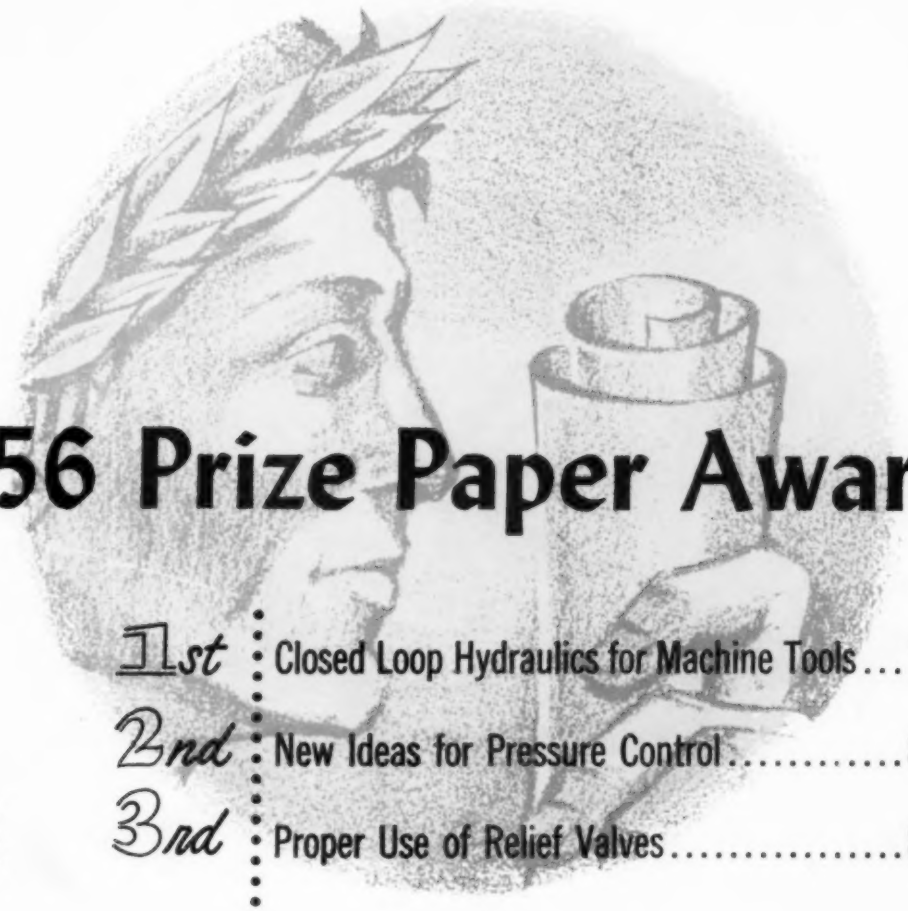


1956 Prize Paper Awards

1st : Closed Loop Hydraulics for Machine Tools ... 76

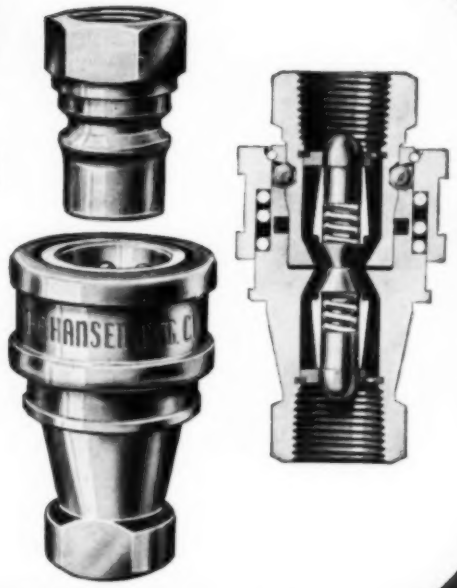
2nd : New Ideas for Pressure Control 82

3rd : Proper Use of Relief Valves 87

For Information about the
FLUID POWER DESIGNERS' GUIDE ISSUE
See pages 114-115

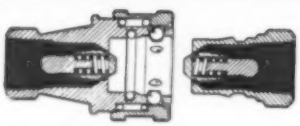
HANSEN

QUICK-CONNECTIVE 2-WAY SHUT-OFF COUPLINGS!



QUICK CONNECTION AND DISCONNECTION

INSTANT AUTOMATIC FLOW OR SHUT-OFF



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AUTOMATICALLY INSTANTANEOUSLY

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. . . finest combination

for Dependable Fluid Power

and Reliable Controls

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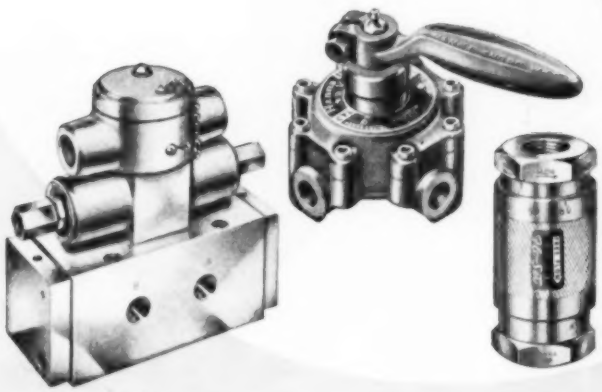

Designed to assure most efficient control, there are many types and sizes of Hanna Valves available for hand, foot and electric operation, for automatic, remote and speed controls.

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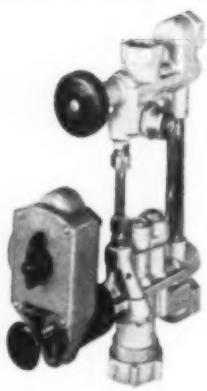
problem:

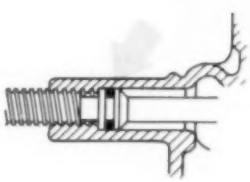
find a low-friction seal that positively seals at extremely low pressures

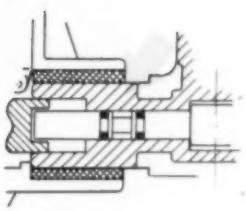
new answer:

minnesota rubber's money-saving new

QUAD® RING







evidence:

THE LINDSAY COMPANY, world's largest manufacturer of automatic home water softeners, uses three QUAD RINGS in its newest valve. Lindsay tested O-rings in the valve, but O-rings leaked at very low pressures. Then Lindsay tested QUAD RINGS, a revolutionary new seal originated and manufactured by Minnesota Rubber. QUAD RINGS sealed perfectly no matter how low the pressure. The Lindsay Company also found that it could open some of the tolerances on the valve parts—and save money—because QUAD RINGS give such a good seal with low friction.

QUAD RINGS are injection molded. Denser, tougher. 4-lip action even seals at less than 1 psi! Only 60-100 micro-inch groove finish needed. No parting line on sealing surface. Eliminates "spiral twist".

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OCTOBER 1956

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for more gripping power– higher production

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Adequate stroke for long jaw travel of S-P Chucks. Balanced for high rpm on machine tools and other applications. Details in Catalog No. 105 (Air) and Bul. 201 (Hydraulic).

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the TOUGH STEEL FRAMES and FEET

PLUS values in power

of HOWELL series one hundred motors give you

A MORE RUGGED MOTOR CONSTRUCTION, GREATER "INSTALLATION FACILITY"

The die-formed, cold-rolled steel frame of a Howell Series 100 motor takes the impact of a dropped hammer or other accidental blow with hardly a dent . . . and never a crack to show. Or take the more common installation accidents . . . too much tightening on the mounting bolts or the shock of the motor dropped too hard. Howell's steel mounting feet have the resiliency to take punishment that would crack the ordinary cast iron mountings.

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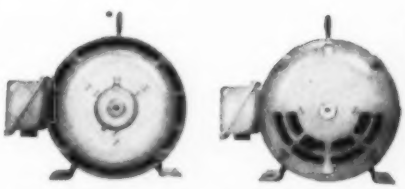
It all adds up to "installation facility" . . . meaning freedom from trouble when these motors are being put to use on machines. Consider the delays and expense you can save by reducing motor damage and you'll specify the modern steel frame construction of Howell Series 100 motors every time.

GET THE PLUS values THAT COUNT....specify HOWELL series 100 motors

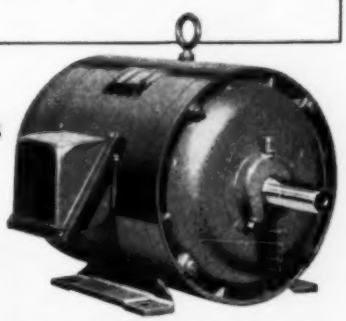


TEFC—open interchangeability

The totally enclosed fan-cooled and open drip-proof or weather-protected types of Howell Series 100 motors have all major dimensions alike, except length. Emergency interchanges are easy.

heat-source ventilation

Wide slots in the stator provide 50% more contact between cooling air and stator laminations, main source of motor heat. Cool running Series 100 motors last longer.



smaller, lighter, better looking

Save machine and storage space, save shipping weight, and get new functional streamlining that matches the motor to your most modern machine design or production equipment. Why put up with dust catching fins on a motor, when sleek good appearance costs no more.

For more details on Series 100 motors, write for Bulletin N-100-R

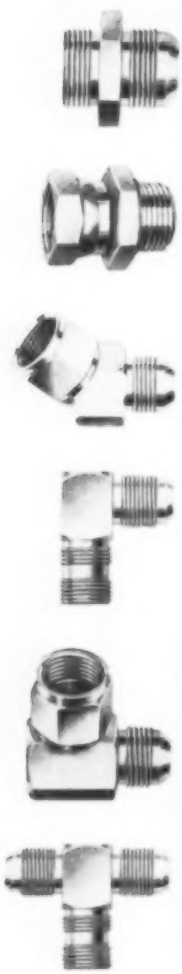
PRECISION-BUILT MOTORS FOR INDUSTRY SINCE 1915

HOWELL Red Band MOTORS

HOWELL MOTORS

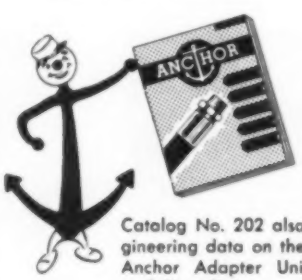
HOWELL ELECTRIC MOTORS COMPANY, HOWELL, MICHIGAN

A WIDE SELECTION of ANCHOR SAE Straight Thread "O" Ring Boss Adapters



They're new

— and especially designed for use with the new SAE Boss. They comply with the SAE Boss Standards as shown on Page 825, 1956 SAE Handbook. Anchor SAE Straight Thread, "O" Ring, Boss Type Adapters insure positive, leakproof connections. The positive "O" Ring seal eliminates the need for excessive tightening—therefore removing the danger of thread distortion, and cracking and distorting of valve body seats — common causes for leaks. Proper positioning of hoses is conveniently accomplished, avoiding twisting strains. They may be removed and re-installed many times without impairing efficiency. Anchor's new SAE Boss Type Adapters are now available in a large range of sizes and in quantities to satisfy your needs. Dimensional diagrams, cross-sectional views and engineering data on these new SAE Adapters are given in the new Anchor Catalog No. 202—write for your copy.



Andy Anchor says:

Catalog No. 202 also gives you engineering data on the broad line of Anchor Adapter Unions, Adapters and Pipe Fittings.

ANCHOR COUPLING CO. INC.

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PRESSED-ON HYDRAULIC HOSE ASSEMBLIES . . . including high pressure two and three wire braid hose assemblies, medium and low pressure one wire braid assemblies, medium and low pressure "Hi-Burst" two rayon braid, low pressure multi-purpose and low pressure suction return assemblies are covered in the Anchor Coupling Co. Inc., Catalog No. 100. In addition to product information, this catalog also contains helpful thread information, methods for computing length of hose assemblies, flow charts and nomographic chart. Coupling styles described include the Anchor exclusive Ductile sleeve, and Anchor "Max-Flo" Hose Couplings. Spring guards are illustrated and described. Catalog No. 100 may be had by writing to Anchor Coupling Co. Inc., 379 No. Fourth Street, Libertyville, Illinois.

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SAE "O" RING BOSS TYPE FITTINGS . . . designed to the new SAE Boss standards, shown on Page 825, 1956 SAE Handbook, are illustrated and described in complete mechanical detail in Anchor's New Catalog No. 202. The "O" Ring seal insures a positive, leak-proof connection without need for, or danger of thread distortion, twisting strain, cracking and distorting of valve body seats, common causes for leaks. This catalog also presents a wide selection of Adapter Unions, Pipe Fittings, and standard Boss & Bulkhead Adapter Unions. Information contained is complete with dimensional diagrams, cross-sectional views and engineering data. Write to Anchor Coupling Co. Inc., 379 North Fourth Street, Libertyville, Illinois for a copy of Catalog No. 202.

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RE-USABLE AND CLAMP TYPE HOSE COUPLINGS . . . in wide selection, are covered in the new Anchor Catalog No. 301. Featured is the Anchor exclusive "Duloc" Re-usable Coupling which is ideal for quick emergency repairs and for plumbing of experimental machines prior to production scheduling to determine proper lengths wanted. The "Duloc" Coupling is detachable and reusable many times without need for replacement parts. It is easy to install, even in confined places. Also illustrated and described in Catalog No. 301 are other styles of Re-usable and Clamp Type Couplings for high, medium and low

pressure applications. Write to Anchor Coupling Co. Inc., 379 North Fourth Street, Libertyville, Illinois.

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SPLIT-FLANGE HYDRAULIC HOSE ASSEMBLIES . . . featuring the Anchor exclusive Flanco 4-Bolt Split-Flange Coupling are described in Anchor Catalog No. 400. They are available in Pressed-on Style for o iginal equipment installations—Clamp Type, for immediate repairs or special assembly installations, and Weld-Type for connecting pipe or tubing to system components having an SAE 4-bolt port boss, or for pipe to pipe connections. Widely used for high, medium and low pressure hydraulic, and for suction return applications. Anchor Flanco 4-Bolt Split-Flange Couplings meet SAE standard requirements shown on Page 823, 1956 SAE Handbook. Anchor Catalog No. 400 may be had by writing to Anchor Coupling Co. Inc., 379 North Fourth Street, Libertyville, Illinois.

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LPG HOSE ASSEMBLIES . . . with Pressed-on, Reusable and Clamp Type Couplings are described in Anchor Catalog No. 500. The Pressed-on Type assembly is available in three hose styles: one-wire braid style LPW for 350 lb. working pressure two-rayon braid Style LP for 350 lb. working pressure and Anchor LP51 hose for 250 lb. working pressures. Styles LP and LPW have tough neoprene covers perforated to protect the covers from blistering due to gas which may permeate the tube. Style LPG carries UL approval and has rayon braid reinforcement, special tube and perforated black rubber cover. Reusable and Clamp Type Couplings offer advantages of quick emergency repairs, minimum downtime and inventories. Request Catalog No. 500. Anchor Coupling Co. Inc., 379 No. Fourth Street, Libertyville, Illinois.

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AUTOMOTIVE, AIR AND FREON HOSE ASSEMBLIES . . . A wide selection, of low pressure, synthetic hose, Pressed-on Coupling Assemblies, suitable for use with gasoline, oil, diesel fuel, air, water, grease, kerosene and common hydraulic fluids, is presented in Anchor Catalog No. 601. Also described are special tube-hose combination assemblies such as are used for power steering and a complete range of Freon handling Assemblies. A copy of this catalog may be had by writing to Anchor Coupling Co. Inc., 379 North Fourth Street, Libertyville, Illinois.

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KNOW

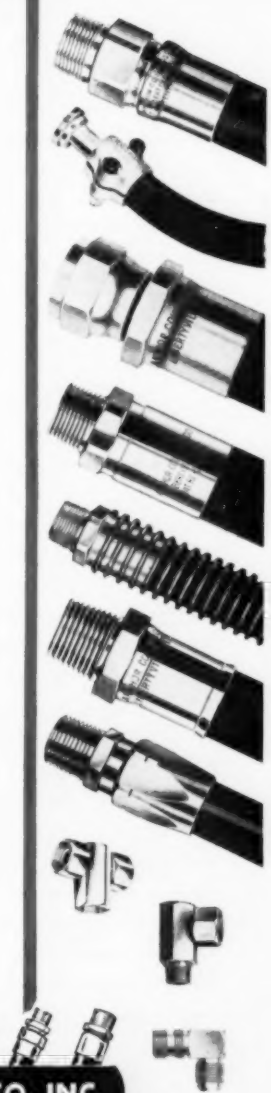
that you have the Right Hose Assembly always . . .

Specify **ANCHOR**

Whether for high, medium or low pressure applications, Anchor offers you the most specialized and complete line of hose assemblies to choose from. This extensive line offers you many exclusive design features, produced to exacting manufacturing standards, that will provide an extra margin of safety for greater dependability of your equipment. Be sure you have all the facts on the Anchor exclusive 4-Bolt Split-Flange Couplings, which are designed to the new SAE standards shown on Page 823, 1956 SAE Handbook; and the new Anchor SAE Straight Thread "O" Ring Boss Adapters, conforming to new SAE Boss standards, Page 825, 1956 SAE Handbook. Then there are the time-proved Anchor assemblies with Clamp Type-Reusable and Pressed-On Couplings of every description needed for hydraulic applications. In the special class, and designed to your specific requirements are: special hose and tube combination assemblies for power steering, Freon 12 and regular hydraulic service. Our three plants, located in Libertyville, Illinois; Dallas, Texas and Plymouth, Michigan insure prompt consideration and expediting of every order you place.

Special Catalogs illustrating and describing all Anchor Hose Assemblies, Couplings and Fittings are shown in the adjoining editorial columns on these pages. They will be sent to you immediately on receipt of your request.

Write for them!



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Fluid Power Lines

about Applied Hydraulics

ADVANCING FLUID POWER . . . One important reason APPLIED HYDRAULICS offers $1200 in awards each year for articles entered in the Prize Paper Contest is to give recognition to men who are doing work which advances the application of fluid power. Winners of the three top prizes are engineers who fully deserve this recognition for their work. Cash awards will be presented to these winners by AH's publisher, Irving Hexter, at the Thursday, October 18th luncheon meeting of the NCIH.

To all engineers . . . machine designers, production, maintenance and management men who submitted papers go our thanks. All prize winning papers and most of the papers awarded honorable mention on page 75 will be published next year.

For their great care and the many hours they devoted to evaluating the entries AH wants to thank this year's contest judges: H. A. Campbell of Bell Aircraft, Frank Schuster of Allis-Chalmers, and J. J. Yates of General Motors.

For your copy of the
1957 Contest Rules Booklet
Circle 350 on Reader Service Card.

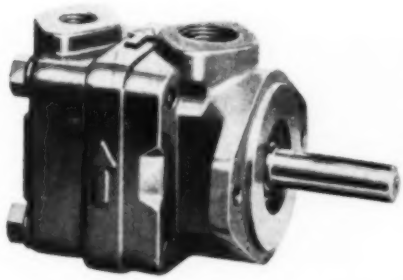
E. L. DIX AND PAUL MAKER . . . Judges awarded top prize of $500 in the 1956 AH Contest to these two men. Their article starts on page 76. Mr. Dix is a project engineer in the machine design division of Bryant Chucking Grinder Company. He has been with Bryant since 1940. During these years, he has been chief tool designer for the boring machine division, has done development work in centerless grinding, and is presently doing development work on hydro-mechanical servo-controlled machines which is the subject of his prize winning paper.

Paul Maker recently left Bryant where he was senior research engineer for six years to join the Research Laboratories Div. of Bendix Aviation Corp. in Detroit as staff engineer. He is doing advanced research and development of machine tool control systems.

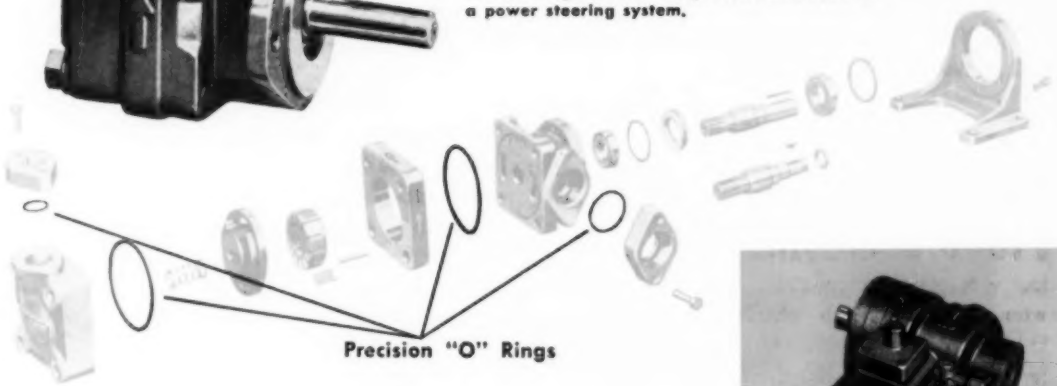
ROBERT RAYMOND . . . Winner of the $300 second award is well known to AH readers. Last year his paper "Series Connected Cylinders for Synchronized Control" (APPLIED HYDRAULICS April 1956) won fourth prize in the contest. And last month he authored the article "Variable Pump Displacement by Pulse Generation". So it's pretty obvious that Bob's day-to-day work is all hydraulics. And from his approach to solving fluid power problems it's obvious that he has done graduate work in electrical engineering. At Simplex Engineering in Zanesville, his work involves research for product design and the development of circuits for all types of industrial applications.

LEN KAPLAN . . . Here's another engineer who is involved in practical fluid power problems every day. He's chief engineer for Lax Industrial Products in Cleveland. In this spot he's the trouble-shooter and circuit designer at whom the company's sales engineers throw all their problems. This makes him very qualified to write his prize winning article on the proper use of relief valves. Len is a Case Institute of Technology graduate in mechanical engineering.

Precision "O" Rings protect the Heart of Hydraulic Power Steering Systems.



Precision "O" Rings provide positive hydraulic oil seal in this 1500 P.S.I. Mobile pump in a temperature range up to 160°F. Quality control in "O" Ring manufacture protects this heart of a power steering system.



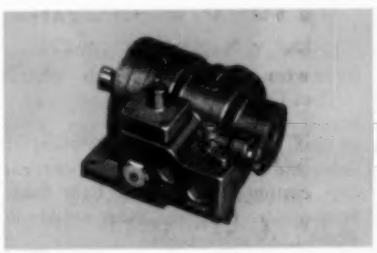
Precision "O" Rings

There can be no compromise on quality and reliability in hydraulic power steering pumps. VICKERS Incorporated, of Detroit, Mich., the world's largest manufacturer of fine hydraulic pumps, use Precision "O" Rings to assure dependable, long life performance under exacting conditions.

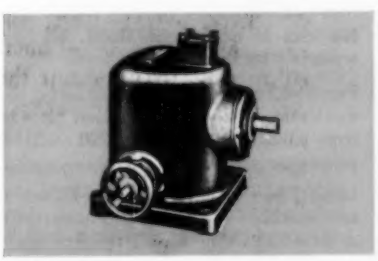
Precision "O" Rings are used in the majority of VICKERS mobile and industrial hydraulic pumps. For VICKERS Incorporated and hundreds of other manufacturers, the use of Precision "O" Rings means economical, efficient, leak-proof operation.

Precision compression molded "O" Rings are rigidly inspected – quality-controlled – meet all military and commercial specifications – the finest made! Precision can furnish the size and compound that fits your product requirements.

Place your sealing problem in the hands of an expert – the Precision engineer. He can assist you in product design. Rely on Precision, the world's largest exclusive producer of "O" Rings.



In VICKERS constant delivery vane type pumps, used on industrial machinery, Precision "O" Rings are used in pump, unloading and pressure relief valve sections to provide effective seals against hydraulic oil leakage.



In VICKERS variable delivery piston type pumps, used on industrial machinery, Precision "O" Rings give exacting service in sealing against hydraulic oil pressure up to 3000 P.S.I.

Write for your free copies of Precision catalogs on "O" Rings and Dyna-seals

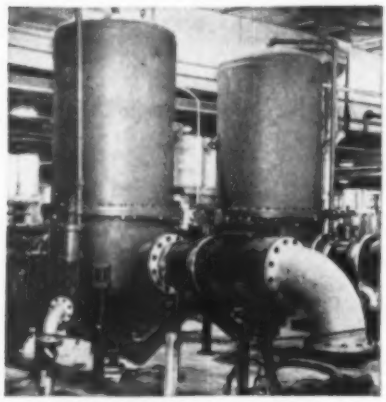
Precision Rubber Products Corporation • "O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio

Canadian Plant at: Ste. Thérèse de Blainville, Québec

Circle 109 on Reader Service Card

FILTRATION NEWS



CUNO FLO-KLEAN installed. These units filter 2500 gpm of water for steel mill.

Self-cleaning filter for up to 15,000 GPM!

Looking for sheer fluid-handling capacity in a continuously self-cleaning filter?

Then Cuno's FLO-KLEAN is the unit for you. It's particularly adapted to removal of sand, metal chips, abrasive-wheel particles and similar solids from water, coolants, cutting oils and other light fluids—*in quantity*. Here are some outstanding FLO-KLEAN advantages:

Continuous self-cleaning—No interruption to fluid flow. No expensive duplex installation needed. FLO-KLEAN is cleaned by continuous backwash and occasional draining of accumulated particles. Automatic blowdown is available.

No loss of backwash fluid. All backwash is returned to system.

Positive removal of all solids larger than minimum specified particle size. Sizes run from 0.0025 to 0.030 inch (220 to 20, approximate screen equivalent).

Long life—A battery of FLO-KLEAN filters, installed in 1938, is still in operation. A FLO-KLEAN in an oil refinery ran 24 hours a day, seven days a week for 5½ years: total downtime 20 minutes due to plant power failure!

Write for complete technical data on this high capacity, self-cleaning filter for your industrial filtration problems. Ask for Catalog No. 052. The Cuno Engineering Corporation. 2-10 South Vine St., Meriden, Conn. 6.7

CUNO ENGINEERED FILTRATION

AUTO-KLEAN (edge-type) • MICRO-KLEAN (fibre cartridges)
FLO-KLEAN (wire-wound) • PORO-KLEAN (porous stainless steel)

Fluid Power Lines

continued

ATOMIC ENERGY . . . The keynote session of the 12th annual National Conference on Industrial Hydraulics will be on the subject "Hydraulic Applications in Atomic Energy". Here is a new field . . . the generation of power from atomic energy . . . which is made practical by the proper application of all engineering sciences including hydraulics.

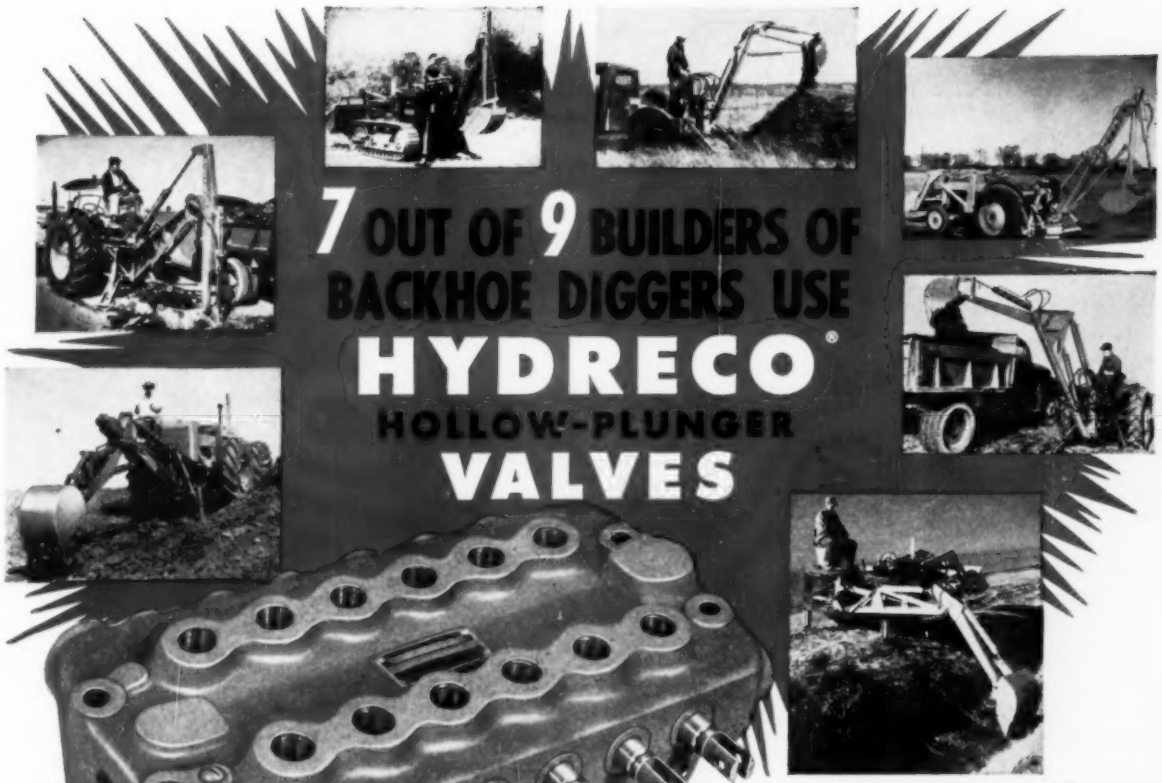
It's of course no surprise to find hydraulics being used in reactor design. The need for developing large forces in a small package, for providing simple remote control, and for obtaining safe stepless infinite speed control is present in all fields from Atomic energy to Zipper manufacturing.

NAVAL JOB . . . Back at the turn of the century, the Navy was applying hydraulic drives. They've been a big user and developer of fluid power systems. A typical application recently made by the Coast Guard is described in the article by R. J. Mitchell, page 125. A 200 hp transmission reduces cost and saves space in the installation of hoist machinery.

SMOOTH TABLE MOTION . . . Dave Hutchinson of Sundstrand describes a "No Jump" circuit in his article starting on page 128. One of the inherent characteristics of a pressure compensated flow control valve is . . . it takes time for the compensator spool to move into a controlling position when the table is first started in feed. During this time, the hydraulically powered table can jump. Dave show's a circuit which eliminates this skip when the operator jogs the control on a small horizontal milling machine.

HERE'S A CHALLENGE . . . During our discussions about feed circuits, we usually get involved with feed inaccuracies caused by oil compression. In all cylinder feed applications, feed rate is subject to variation in oil column length due to pressure changes and the resultant oil compression. With a long stroke and bad cutter tooth engagement pattern the dimensional change can be severe.

If you have worked out a climb mill feed circuit that compensates for oil compression or is designed so that oil compression does not affect accuracy, let's hear about it.



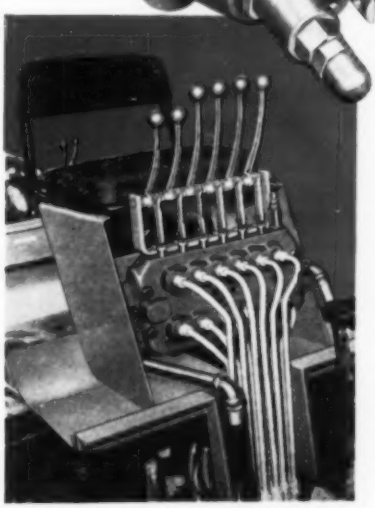
7 OUT OF 9 BUILDERS OF BACKHOE DIGGERS USE HYDRECO® HOLLOW-PLUNGER VALVES

Why is it so important *to YOU* that 7 out of 9 builders of Backhoe Diggers use HYDRECO Hollow-Plunger Control Valves? Analyze the functions involved in this Fluid Power application, and the answer is clear. Here is a rugged service application requiring multiple manual control of Fluid Power operations, good throttling, and easy-to-reach controls. All these features are combined in Hydreco Hollow-Plunger Valves to give the operator a feeling of "playing" the machine.

Hydreco Hollow-Plunger valves are perfect for this application. Check valves built into the plungers absolutely prevent back flow and cross flow between cylinders, therefore rapid sequence of operations is possible on multiple cylinder machines.

The Hydreco valve enables the operator to level, dig, hoist, swing and dump quickly and easily. The operator has the touch he needs to get the best out of a good machine, day in and day out. That's why operators like Hydreco Hollow-Plunger Valves.

Designers like Hydreco valves too, because with all components built in, they come smaller and fit into tight places more easily. For smoother operation, for more work at less cost — apply HYDRECO Hollow-Plunger Valves to your multiple-function equipment!



Hydreco valves are available with up to 6 plungers.

Member NFPA

KALAMAZOO DIVISION
THE NEW YORK AIR BRAKE COMPANY

9004 E. MICHIGAN **KALAMAZOO • MICH.**

INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

Kalamazoo Division
The New York Air Brake Company
9004-10 East Michigan
Kalamazoo, Michigan

Kindly send me full information on Hydreco Hollow-Plunger Control Valves.

Name_____

Company_____

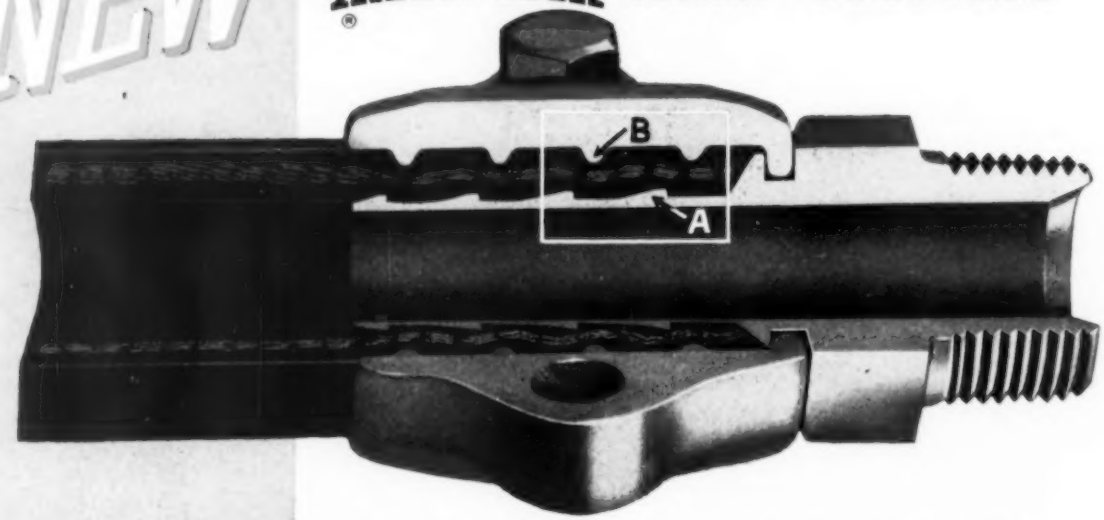
Address_____

City_____ Zone_____ State_____

Circle 97 on Reader Service Card

NEW Eastman

INTER-LOCK® CLAMP COUPLING



EASTMAN MFG. CO. announces its New **Inter-Lock** Clamp Coupling—offering *exclusive grip advantages* available in no other coupling of its type.

EXCLUSIVE EASTMAN INTER-LOCK FEATURES

Eastman's New **Inter-Lock** Clamp Coupling provides positive positioning through accurate machining of clamp and insert—as the outside rib of the clamp is locked between the collar and hex of the insert, before tightening.

The accurate location of the clamp over the insert assures alternate mating of the barbs of the insert (A) with the circular ribs of the clamp (B).

Hose is uniformly compressed into each alternating recess—increasing the holding power of the Clamp Coupling—thereby creating **Eastman's Exclusive Inter-Lock Grip.**

Longer service is assured because hose construction is not weakened by pinching, as it may be if ribs and barbs were permitted to fall directly opposite each other.

EASTMAN'S Exclusive **Inter-Lock** feature is another example of advanced design and engineering which gives you greater value, plus the *all-important competitive advantage* of superior product performance and customer satisfaction in the field.

Look to EASTMAN . . . *first in the field* of Hydraulic Hose Assemblies . . . for continued leadership in design and engineering—plus the highest quality material and workmanship.

STANDARD INSERTS FOR EASTMAN INTER-LOCK CLAMP COUPLING

For low, medium and high pressure hose up to 5000 psi. working pressure. Available for hose sizes ranging from ⅛" to 2" I.D.—according to pressure requirements. Also available for angle and straight tube applications.

SWIVEL FEMALE

MALE PIPE

MALE FLARE

INSERT FEATURE
Beveled shoulders of barbs permit easy insertion into hose.

WRITE for Standard Sizes or send your blueprints and specifications.

SAFEGUARDING INDUSTRY'S Lifelines of Mobile Power

Eastman
first in the field

MANUFACTURING COMPANY
Dept. AH-10, Manitowoc, Wis.

Circle 48 on Reader Service Card

LETTERS
to the editor

Address your letters to: Editor, APPLIED HYDRAULICS Magazine, 812 Huron Rd., Cleveland 15, Ohio.

Cost of Air

An article appeared in the October 1952 issue of APPLIED HYDRAULICS titled "A Beginners Course in Basic Pneumatics: Section II-The Distribution System". A tabulation of the cost of air line leaks showed figure based on 7 cents per 1000 cu ft.

Can we have a breakdown as to how you arrived at this cost factor.

J. J. HIGH
Staff Engineer
American Viscose Corporation
Philadelphia, Pa.

Cost of air varies considerably from plant to plant. We chose 7 cents as an acceptable average which emphasizes the dollars which can be lost due to an air leak.

In order to determine the actual cost of compressed air in any plant, an analysis of several factors must be made. These are: 1. average air consumption per month; 2. the amount of money set aside for fixed charges and repairs on the compressed air equipment; 3. cost of normal maintenance of the equipment; 4. cost of any cooling water used in the compressor equipment; 5. cost of power required to produce the compressed air.

These charges can vary considerably throughout the country. Using these factors, cost of compressed air and loss due to air leaks can be calculated.

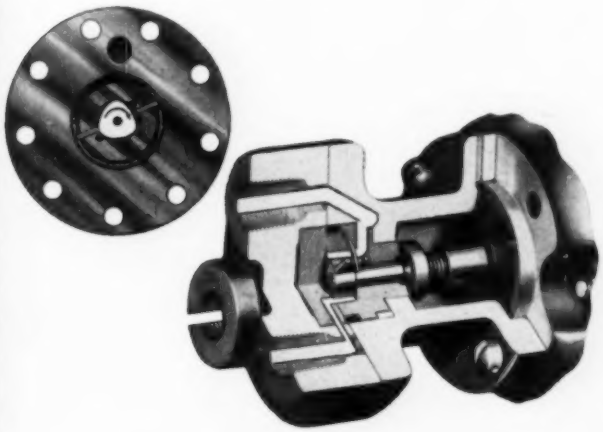
Automation Seminars

I have been given the assignment of presenting four, two-week seminars in automation this Fall to a group of about 80 men from Australian Industry. Emphasis will be on practicable, realizable automation, generally of the simplest

Continued on page 16

WELDON
FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.

Compact • Light Weight

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

THE WELDON TOOL COMPANY
3000 WOODHILL ROAD · · · CLEVELAND 4, OHIO

Circle 153 on Reader Service Card

Koppers 2-Piece Sealing Rings are installed on hot air shut-off valves manufactured for aircraft by Hydro-Aire, Inc. Ring inners are of stainless steel . . . ring outers are made of high chrome alloy heat resistant cast iron. Diameter is 1¾"

Koppers 2-Piece Rings Solve High Temperature Sealing Problems for Hydro-Aire

A Product of Continuous Research and Development by KOPPERS

To solve a sealing problem at high temperatures, Koppers engineers created a new sealing ring for Hydro-Aire, Inc.

Hydro-Aire, Inc. . . . a subsidiary of Crane Co. . . . manufactures hot air shut-off valves for aircraft applications. Ordinary rubber "O" rings couldn't withstand the high temperatures involved.

Koppers engineers designed a 2-Piece Sealing Ring with extremely close tolerances that provides maximum sealing at high temperatures. Primarily designed for aircraft applications, this new type ring can be used for sealing fuel oil and hydraulic oils as well as hot air and other gases.

The Hydro-Aire application is an interesting example of how highly trained Koppers engineers can solve customers' sealing problems. Koppers engineers in your area will be glad to study your applications and design the proper type of ring.

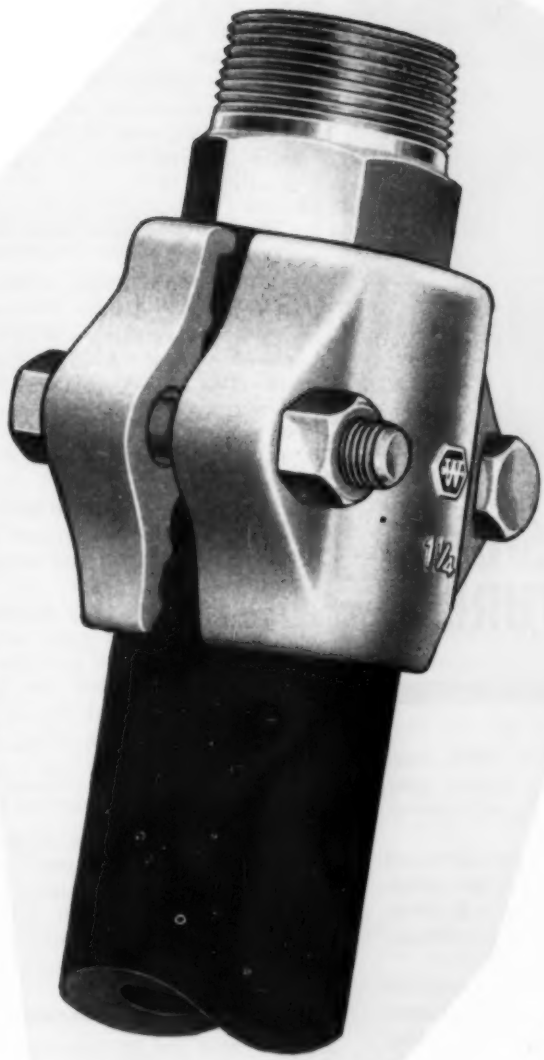
KOPPERS®

To lower your production costs, bring your ring problems to Koppers. Write to KOPPERS COMPANY, INC., 1510 Hamburg Street, Baltimore 3, Maryland.

RING-TYPE SEALS

Koppers Company, Inc., Metal Products Division
Piston Ring and Seal Department

Engineered* Products Sold with *Service

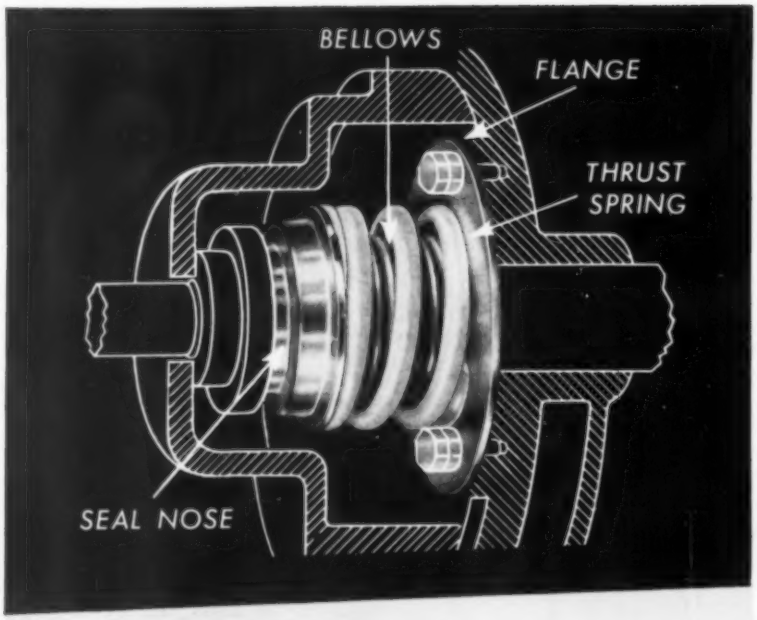


TAME THE TOUGH ONES

Yes, taming the tough ones is easy for the Weatherhead new clamp-type hose end. Easily assembled . . . positive grip . . . maximum versatility for high-pressure air, hydraulic and steam lines. Requires no hose-skiving or special tools. Cadmium-plated malleable iron to resist corrosion. It's reusable! Sizes: 1/4", 3/8", 1/2", 3/4", 1", 1 1/4", 1 1/2" and 2". Immediate delivery.

WEATHERHEAD

THE WEATHERHEAD CO., FT. WAYNE DIV., DEPT. A-10
128 WEST WASHINGTON BLVD., FT. WAYNE, INDIANA
In Canada: The Weatherhead Co., Ltd., St. Thomas, Ontario



HOW TO LEAKPROOF SHAFTS AT HIGH TEMPERATURES

It makes no difference whether you expose them to a -100°F. deep freeze or a singeing 600°F. Fulton Sylphon rotary bellows seals will still leakproof rotating shafts against corrosive, explosive or contaminating fluids and gases.

One reason is that this seal features a seamless, flexible metal bellows which expands, contracts and deflects to apply the proper sealing pressure at all times. Furthermore, the Fulton Sylphon bellows seal is made with silver solder for extra high-temperature protection.

You can obtain Fulton Sylphon bellows seals in rotating or stationary types for pressures up to hundreds of pounds and shaft speeds up to 20,000 RPM. For the atomic energy and other industries, they're also available with welded construction to solve special contamination problems.

SEND FOR BULLETIN 827-TU

V-FACE SEALS

Formerly called flat seals, Fulton Sylphon V-FACE Seals assure leakproof sealing of flat surfaces at temperatures from -100°F. to 800°F. and at pressures up to 5,000 psi.

Robertshaw-Fulton
Mr Controls
CONTROLS COMPANY
FULTON SYLPHON DIVISION · Knoxville 1, Tenn.

LETTERS to the editor

kind, for the small or medium-sized plant.

As the leading journal of hydraulic mechanisms and control, I am writing you to request assistance in the form of reprints of articles.

FRANK K. SHALLENBERGER
Professor of Industrial Management
Stanford University

We have sent single copies of all available reprints. Additional copies of any reprints will be supplied on request. There's no charge for single article reprints as long as a supply is available.

Tracer Valves

For sometime we have been receiving APPLIED HYDRAULICS and find it very helpful and interesting.

We are at present in search of a hydraulic tracer valve which can be incorporated into the design of our product. We have failed to find a manufacturer of such a valve. Can you help?

H. C. HAAG
Haag Machine Company, Inc.
Hawthorne, N. J.

We have sent a list of manufacturers who make a tracer valve for which there have been a number of installations on standard and special machine tools.

Penn State Seminars

I have had an opportunity to review your MASTER CATALOG of Fluid Power Products and find it about the most complete coverage of the fluid power and related component field I've seen.

In seminars at Penn State heavy stress is placed in laboratory work on hydraulic, pneumatic and electrical control. We also plan to offer our senior and graduate engineering students what we believe to be, the first automation course for University credit this Fall. We plan to place heavy emphasis on practical applications of hydraulic and pneumatic systems.

We would like your assistance in developing a first rate laboratory having fluid power equip-

ment. We also wish to obtain copies of the MASTER CATALOG for use in this course. The technical information in the Catalog is the finest collection I've been able to find anywhere.

CHESTER LINSKY
The Pennsylvania State University
University Park, Pa.

We're pleased to learn of your educational work in the Fluid Power Field. Undoubtedly many manufacturers of hydraulic and pneumatic components would be willing to supply equipment for your laboratory. The MASTER CATALOG *or any issue of* APPLIED HYDRAULICS *can serve as a guide to companies for you to contact. We also suggest that you write to the Executive Secretary of the National Fluid Power Association, 1618 Orrington Avenue, Evanston, Illinois. The association has a very active committee on education.*

Fine Metering

We read with interest the article "Small Volume Flow Metering" in the July APPLIED HYDRAULICS. Where can we get additional information on the metering pump shown in this article?

R. I. SCHUMAN
Elevator Engineering Co.
Baltimore, Md.

Although this pump is a German development, the author of the article, Karl Schubert, tells us that there are no restrictions to its manufacture. Mr. Schubert can supply detailed information.

Standards

Where can I get a copy of the JIC Hydraulics Standards? Also where can I get a copy of AN standards for steel tube fittings. Please forward names of manufacturers of AN steel tube fittings.

ANTHONY R. PATTERSON
Raybestos-Manhattan, Inc.
Manheim, Pa.

For JIC Standards write: JIC, Box 182 Northend Station, Detroit 2, Michigan. For AN standards ask your nearest Airforce Procurement Office. The MASTER CATALOG *of Fluid Power Products provides you with a list of fitting manufacturers.*

Continued on next page

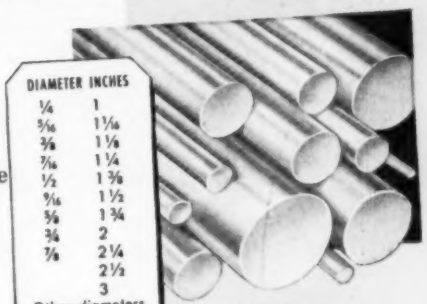
Teflon*...

Your Best Source Is JOHN CRANE

Thickness Inches	Nominal Size
1/16	12 x 12
3/32	18 x 18
1/8	24 x 24
3/16	36 x 36*
1/4	48 x 48*
3/8	
1/2 & Up	

* Can be furnished in 1/2 sheets

SHEET



DIAMETER INCHES	
1/4	1
5/16	1 1/4
3/8	1 1/2
7/16	1 1/4
1/2	1 3/8
9/16	1 1/2
5/8	1 3/4
3/4	2
7/8	2 1/4
	2 1/2
	3

Other diameters on specification

ROD

HERE'S WHY: You can order in quantity and in a wide variety of sizes—and be certain of complete uniformity throughout. Our strict density control assures you thoroughly non-porous Teflon—free from any flaws which might possibly affect your end use or product. Dimensions are accurate to your most critical tolerances—no rejects, waste of material or loss of time. You get product purity—Teflon at its best in every one of its remarkable characteristics. Delivery is prompt—you get the quantity you want when you want it.

Since the availability of Teflon, "John Crane" engineers have worked with Industry to successfully solve innumerable problems and develop new applications. *You can benefit from their experience and know-how.*

TYPICAL SIZES INCHES	
O. D.	I. D.
3/8	1/4
1/2	3/8
3/4	1/2
1	3/4
1 1/2	1
2 1/2	1 1/2
3	1 3/4

TUBING

Characteristics of Teflon

CHEMICAL
Completely inert.

ELECTRICAL
Very high dielectric strength.
Extremely low power factor.

THERMAL
Temperature range
−300° to +500° F.

MECHANICAL
Strong, flexible, weather resistant.

LOW COEFFICIENT OF FRICTION
Absolutely non-stick.

* DuPont Trademark

Request full information and ask for our bulletin, The Best in Teflon. Crane Packing Co., 6405 Oakton St., Morton Grove, Ill., (Chicago Suburb)

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS

National offers you

Top quality O-Rings, dependably uniform, delivered on time!

Here's the way National insures uniform high quality in National O-Rings:

All ingredients are of highest quality, carefully inspected before compounding. Compounding is done under strict controls to insure absolute uniformity of batches. Molding is done on modern equipment by skilled veterans in O-Ring manufacture. Rings are given a complete precision trim, then complete inspection. Every precaution is taken to insure that no O-Rings with cuts, scratches or mold defects are shipped.

A complete line of industrial O-Rings, including the new small cross-section rings, is available for prompt shipment from convenient warehouses. Prices are most competitive. Call the nearest National Applications Engineer and prove this to yourself!

NATIONAL OIL & GREASE SEALS O-RINGS SHIMS

NATIONAL SEAL

DIVISION, Federal-Mogul-Bower Bearings, Inc.

GENERAL OFFICES: Redwood City, California

PLANTS: Van Wert, Ohio and Redwood City, California

CHICAGO, ILL. . . . *Room 462, McCormick Building, HArrison 7-5163*
CLEVELAND, O. . 210 *Heights Rockefeller Bldg., YEllowstone 2-2720*
DETROIT, MICH. . . . . 13836 *Puritan Avenue, VErmont 6-1909*
INDIANAPOLIS, INDIANA . 2802 *North Delaware St., WAlnut 3-1535*
MILWAUKEE, WIS. . . . 647 *West Virginia Street, BRoadway 1-3234*
NEWARK, N. J. . . . . 1180 *Raymond Blvd., MItchell 2-7586*

LETTERS to the editor

Drawing Room Handbook

Where can I get a textbook on hydraulics which could be used as a drawing room handbook?

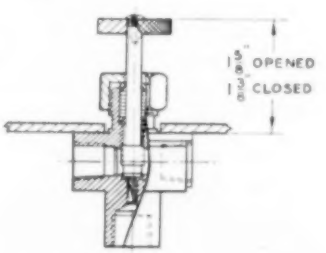
GEORGE W. SINES
Chief Engineer
Easton Car and Construction Co.
Easton, Pa.

The closest book you'll find for this purpose is the MASTER CATALOG OF FLUID POWER PRODUCTS *which we published in October 1955. In this book you'll find a section of technical data, information on sources of supply and much valuable information in the manufacturers' catalogs. Single copies are* $6.50.

A Fluid Power Engineering Index, published in the January 1956 issue of APPLIED HYDRAULICS *lists all text books in the field as well as reports and articles published over the last 25 years.*

Piddling Valve

In your August issue, Mr. Heiser, in his "Ideas from a Sales Engineer", asks why somebody doesn't make a small lapped fit, straight needle valve with a notch along the stem, as a good piddling valve.



Here's a drawing of a valve made by The Meriam Instrument Co. It's good for 2000 psi service.

PAUL B. SHANNON
Manufacturers' Representative
Chicago, Ill.

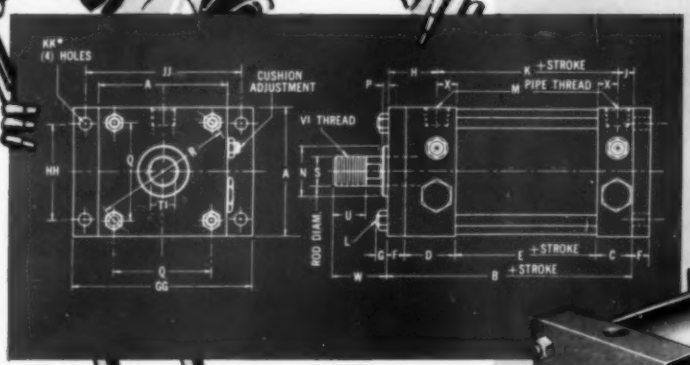
Electric Motors

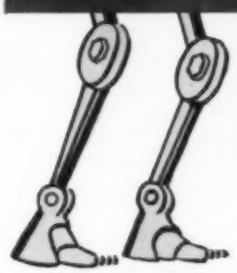
Your article "Electric Motors" published in the April issue has been making the rounds of our staff. We have found it most interesting and valuable. Can we purchase 100 reprints? If they are not available, can we have permis-

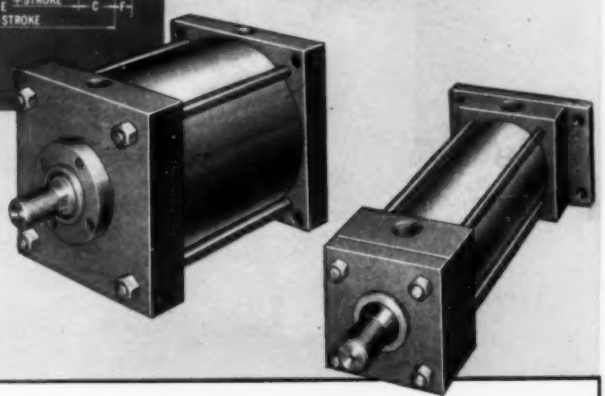
Continued on page 20

FOR AUTOMATION IT'S Logan

AIR AND HYDRAULIC FLUID POWER EQUIPMENT







LOGANSQUARE NONROTATING DOUBLE-ACTING CYLINDERS

Bore	A	B	C	D	E	F	G	H	J	K	L	M	N +.000 −.003	P	Q ±.005	R	S	T¹	U	V¹	W	X	GG	HH	JJ	KK	AD	AE
1½	2	4	1	1½	1½	⅜	⅜	1⅛	⅞	2½	⅝-28	¾	1⅜	⅛	1.458	2⅛	⅜	⅜	⅝	⅝-18	1⅜	⅝	3⅜	1⅞	2⅝	⅛	—	—
2	2½	4	1	1½	1½	⅜	⅜	1⅛	⅞	2½	⅝-24	¾	1⅜	⅛	1.856	2⅝	⅜	⅜	⅝	⅝-18	1⅜	⅝	4⅛	1¹¹⁄₁₆	3⅜	⅜	—	—
2½	3	4¾	1	1½	1⅜	⅜	⅜	1⅛	⅞	2½	⅝-24	¾	1⅜	⅛	2.209	3⅛	⅜	⅜	⅝	⅝-18	1⅜	⅝	4⅝	2⅛	3⅞	⅜	—	—
3	3¾	5	1⅜	1¾	1⅜	⅜	⅜	1¹¹⁄₁₆	⅝	2¾	⅝-24	½	1⅜	⅛	2.651	3¾	1	⅜	1⅛	1-14	1⅞	11⁄16	5½	2⅜	4¹¹⁄₁₆	⅛	—	—
4	4½	5½	1⅜	1⅜	1⅜	⅜	⅜	1¹¹⁄₁₆	⅝	3	⅝-24	½	1⅜	⅛	3.402	4¹¹⁄₁₆	1	⅜	1⅛	1-14	1⅞	11⁄16	6¾	3¹¹⁄₁₆	5⅞	⅛	—	—
5	5½	5½	1¾	1¾	1¾	⅜	⅜	1¹¹⁄₁₆	⅝	3½	⅞-20	½	2	¼	4.154	5⅞	1⅜	⅜	1⅛	1-14	1⅞	11⁄16	7½	4⅜	6⅝	⅝	—	—
6	6½	6¾	1½	2	2	⅜	½	1¹¹⁄₁₆	11⁄16	3½	½-20	⅝	2	¼	4.993	7⅛	1⅜	1⅜	1⅝	1⅜-12	2½	11⁄16	8½	4⅞	7½	⅝	—	—
8	8½	6¾	1½	2	2	⅜	½	1¹¹⁄₁₆	11⁄16	3½	⅝-18	⅝	2½	¼	6.452	9½	1⅜	1⅜	1⅝	1⅜-12	2½	11⁄16	—	7¹¹⁄₁₆	—	11⁄16	4¾	10¹¹⁄₁₆

Dimensions apply to no-stroke assemblies. Pipe thread is American (National) "Dryseal." Dimensions for cushioned and noncushioned are identical. All dimensions are given in inches. *Use bolts 1/16 smaller than "KK" (mounting holes).

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Direct connected oil pumps for general pressure circulation of oil. High suction lift; pressures up to 100 psi.
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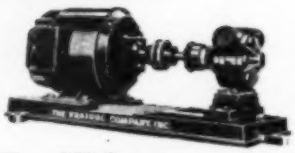

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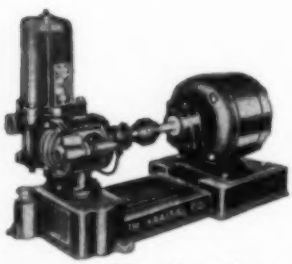

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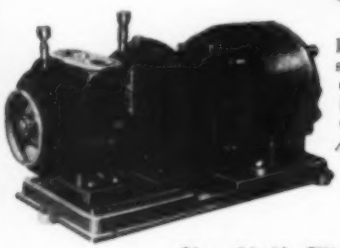

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Mounted at vacuum pump intake, minimizes entry of dust, shavings, extraneous matter. Saves its cost in maintenance time. Sizes ⅜" to 2½".
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LETTERS to the editor

sion to litho-print the article for distribution to students in the Hydraulic Machinery course?

ARNO T. LENZ
University of Wisconsin
Madison, Wisconsin

We don't have 100 copies available. You certainly may have our permission to reproduce the article for distribution to your students.

Plant Course

We read with interest the article in June describing the hydraulic program at Packard-Clipper Division. In reply to the "Editor's Note" we would like to inform you of our program at Dow, Midland Division. We are now setting up a hydraulic laboratory to supplement classroom theory and field training.

I must add that your magazine has provided innumerable leads to information for establishing a program of this type in addition to being a real asset with its many fine articles.

CARL SHAFER
The Dow Chemical Company
Midland, Michigan

In our Briefs columns this month, Dow's training course is detailed.

Fluid Power Index

Can you supply me with a copy of "Air in Hydraulic Transmission Systems" as mentioned under "Fluids, Hydraulic" on page 116 of the APPLIED HYDRAULICS' Fluid Power Engineering Index?

J. K. BRIXIUS
Air-Maze Corporation
Cleveland, Ohio

The "Fluid Power Engineering Index" is a bibliography of articles, books and films produced between 1930 *and* 1955. *Copies of any article can best be obtained by directing your request to the original publisher or by asking your local library for photostats. We can only supply copies of articles which have appeared in* APPLIED HYDRAULICS.

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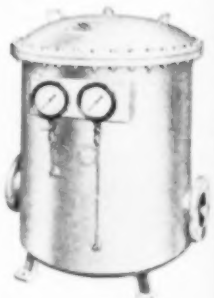

Fulflo Filters provide optimum clarity at ultra-high flow rates. For all industrial fluids—including oils, liquid fuels, chemicals, water, compressed air and various gases. Sizes to handle flow rates up to 1,600 gpm. Pressures to 4,000 psi.

Fulflo Filters feature Honeycomb Filter Tubes, the "precision controlled density" element that filters every drop again and again to give you microscopic clarity. Choice of cotton, acetate, nylon, orlon, dacron, dynel or glass fibres.

Standard models available in steel, stainless steel, rubber lined steel or nickel-plated brass. Custom models engineered to special requirements.

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Honan-Crane Filters offer "clean oil" filtration in diesel, turbine, hydraulic, metal-working and quenching operations. Bulk refill models provide depth filtration with cellulose medium for additive oils and Cranite (fullers earth) medium for straigth mineral oils. Multi-cartridge models feature six different types of cartridges that may be used interchangeably depending on type and degree of filtration desired. Flo-Pac models, installed in line, handle flow rates up to 900 gpm. All have quick-opening covers for ease in changing refills.

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Diesel and gasoline engines get complete protection against the damaging effects of dirty oil with Michiana Lube and Fuel Oil Filters. Designed for low cost filtration and proven in thousands of installations. "Throw-away" or repackable filter elements. Available in a wide range of sizes and models.

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for accuracy—dependability
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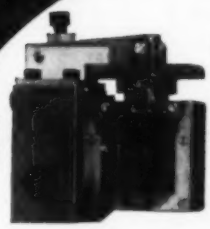

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For working pressure to 3000 psi. Remote control of hydraulic systems for handling non-corrosive fluids.

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Operating pressures to 3000 psi. 40 micron filtration. Replaceable elements. Available in ⅜" and ¾" NPT.

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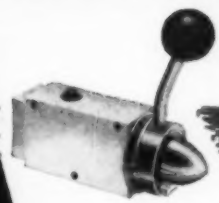

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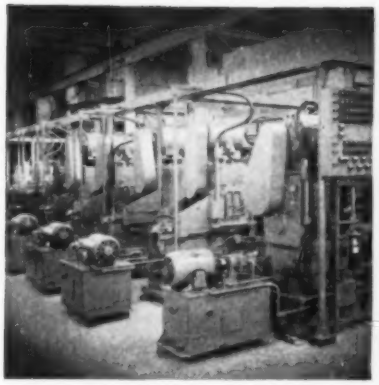
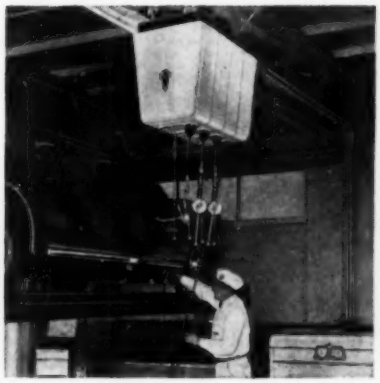
Only Superior SAE Hydraulic Tubing Is Produced with All These "Quality Safeguards"

Here are 10 important steps in Superior's quality-control program for producing hydraulic tubing that meets the highest possible standards:

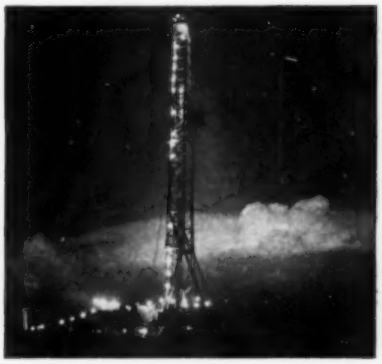
1. *Use of 0.12% maximum carbon content material for ease in hand bending and flaring.*
2. *Use of non-aging steel to prevent loss of ductility during storage and from service fatigue.*
3. *Careful inspection of raw material and in in-process stages.*
4. *Controlled atmosphere annealing for bright scalefree outside and inside diameter.*
5. *Mandrel-drawn close to finish size for smooth inside diameter.*
6. *Assured cleanliness by hot solvent degreasing before all process anneals and shipment.*
7. *Flare inspected on basis of 35% minimum increase on outside diameter.*
8. *100% hydrostatic pressure testing to recommended maximum working pressures.*
9. *All tubing dipped and drained in light, filtered rust preventive.*
10. *Boxed and wrapped in waterproof paper for cleanliness and protection from bending and denting during shipment and in warehouse stock.*





PRACTICAL APPLICATIONS FOR SUPERIOR SAE HYDRAULIC TUBING

Shown here are just a few of the many applications for Superior low-carbon steel SAE hydraulic tubing. (*Beginning at top left*) hydraulic lines on machine tools; construction and agricultural equipment control lines; hydraulic lines for lifts and grease guns in service stations; materials handling equipment; oil-well drilling equipment; oil and fuel lines on aircraft (AMS 5050 E).



When you need a hydraulic system that is dependable and leakproof, specify Superior SAE hydraulic tubing. We specialize in producing seamless low-carbon steel tubing for all hydraulic purposes. In many cases it is produced to specifications higher than standards called for by SAE.

Of Superior's many sizes in hydraulic tubing, some can bear working pressures as high as 12,000 psi. The steel from which it is produced has a maximum carbon content of only 0.12%, which results in high ductility and permits easy hand bending and flaring . . . necessary bends can be made neatly without pinching. Each order of tubing is 100% hydrostatically tested at maximum working pressure. And efficient quality control assures close adherence to specified tolerances. Finished tubing has clean, bright, smooth inner and outer surfaces. It is furnished in dead soft-annealed temper for ease in bending, and is available in cut, multiple or random straight lengths up to 30 feet, or longer in coiled form.

Whatever your hydraulic tubing requirements or problems may be, bring them to Superior. Our extensive facilities and years of experience are at your service. Superior SAE hydraulic quality tubing is stocked by warehouses in principal cities throughout the U.S.A. For additional technical data on hydraulic tubing, write for Bulletin No. 39. Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

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BRIEFS about fluid power

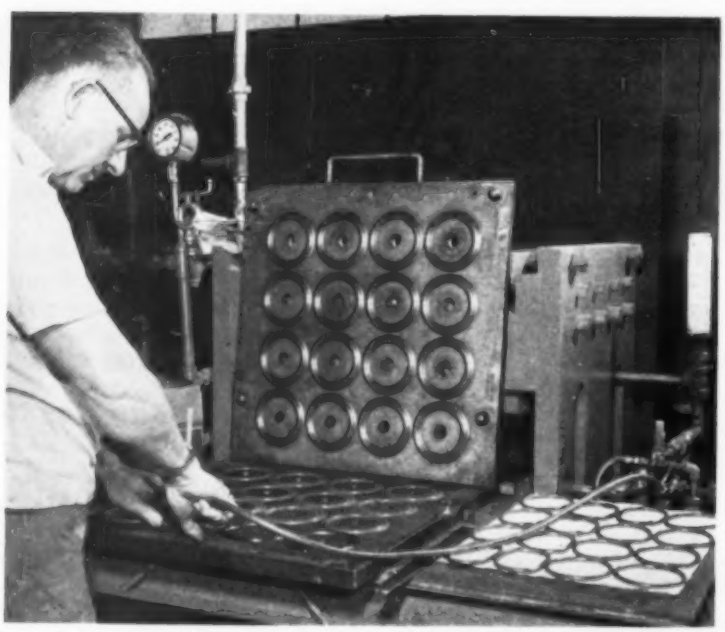
SILICONE O-RING DEVELOPMENTS

• **Close tolerances**—Although high temperature resistance of silicone rubber has stimulated its use in O-rings for over ten years, difficulties in meeting close tolerances have discouraged many design engineers. This obstacle is being overcome by new silicone compounds developed by General Electric.

O-rings molded from these new compounds have the same tolerances as neoprene nitrile or other organic rubbers. No special tools are needed—tooling designed for organic rubbers is being used.

• **Test results**—Thousands of O-rings molded from new silicone compounds are in use. During development measurements were taken on small, medium and large O-rings. Tolerance distribution curves were plotted from tests with 4000, AN6227-29 O-rings, 2000 each of silicone and nitrile rubber, produced in the same mold. The silicone rubber was one of the improved compounds designated SE-371.

These curves show that all SE-371 and nitrile rings fell completely within the AN specified dimensions of 1.600 ± .010 inch ID and .210 ± .005 inch thickness. 85 percent of all the SE-371 rings were within ± .001 inch of the median dimension.



These 4 inch silicone rubber O-rings meet the same tolerances as organic rubber rings made in the same mold. Because of shrinkage difference, silicone rubber O-rings would normally require a special mold.

Photo Courtesy Goshen Rubber Co.

• **Properties**—O-rings from the silicone compound are recommended for many types of hydraulic fluids including petroleum base, water glycol, phosphate esters, and some diester fluids.

In these new stocks, low compression set has been demonstrated over a temperature range of −90 to +400 degrees F. Also of prime importance is oil and hydraulic fluid resistance at temperatures of 350 degrees F. This is better than in any other silicone rubber so far tested.

Moisture absorption of these compounds is zero for all practical purposes, even after total immersion in boiling water for long periods. The improved compounds contain no toxic additives of any kind. The low compression set properties are built into the polymer from which the compounds are made. Most specifications of low compression set and low volume swell in oils are met by these compounds. One shortcoming is in elongation and tear strength which have been described as "borderline, but adequate".

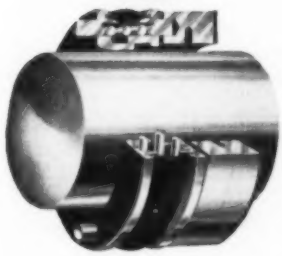
With the problems of tolerances and special tooling eliminated, silicone rubber O-rings, gaskets and other precision molded parts can be applied where requirements of heat or cold, and oil or water are too severe for other rubber polymers. ▼▼▼

Continued on page 28

cooperative research

covers this wide range of products

SHAFT-TYPE OIL SEALS More than 20 types, forming over 7,500 size combinations for shafts from ¼" to 50" O.D., are available — thousands from stock. These seals are used for the vast majority of shaft sealing problems from simplest dust exclusion to high-speed, high-temperature fluid retention and foreign matter exclusion under extremely rugged operation where high sealing efficiency must be maintained over long service life.



END FACE SEALS For critical sealing problems outside the capabilities of shaft-type seals, there are C/R End Face Seals, which operate on the principle that two smooth, flat surfaces, one rotating on the other at right angles to the shaft, form a leakproof seal. They require minimum pressure to maintain face contact, create minimum friction, heat and power loss, and give unsurpassed performance under the most severe conditions.
Typical applications of C/R End Face Seals include: sealing track rollers of crawler tractors; sealing high-speed accessory drives in aircraft; sealing medium speed applications such as gear cases of washing machines, dishwashers and similar home appliances.

SIRVENE SYNTHETIC RUBBER PRODUCTS The advanced level of compounding and molding elastomers and special materials to critical tolerances achieved by C/R Sirvene Engineers is a widely established fact. They will design, compound and produce a part to your exact specifications of hardness, elasticity, and resistance to aging, temperature, oils, solvents or chemicals — with dimensional uniformity and consistent high quality, regardless of quantity. Holding to extremely close tolerances is standard procedure. A typical list of products includes oil seal packings, diaphragms, cups, boots, gaskets, plugs, impellers, valve inserts and way wipers — to name but a few. The experience and facilities available to you from C/R's Sirvene Division are unrivaled in the industry.

SIRVIS-CONPOR MECHANICAL LEATHER PRODUCTS The typical range of mechanical leather products includes oil seal packings, cups, boots, washers, gaskets, couplings and valve discs, but encompasses any part wherein high tensile strength, flexibility, high resistance to pressure, wear, shock, and vibration are desired. Cups of C/R's Conpor impregnated Sirvis leather products are operating at pressures up to 10,000 p.s.i. They are insoluble in most hydraulic oils and compatible with a wide range of other oils, solvents and gases. C/R boots of Sirvis leather, canvas, nylon or elastomer impregnated fabric can be produced in sizes two stories high or not bigger than your thumb for use in the protection of eccentric, universal or reciprocating action. Whatever your sealing or protection problem, bring it to Chicago Rawhide. C/R Engineers are constantly developing new mechanical leather designs for special and universal application.

Please write direct or contact your nearest C/R sales engineer about your problem in fluid sealing or related fields.

CHICAGO RAWHIDE MANUFACTURING CO.

Offices in 55 principal cities. See your telephone book.

In Canada: Chicago Rawhide Manufacturing Co., Ltd., Hamilton, Ontario
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C/R Products: C/R Shaft and End Face Seals • Sirvene (synthetic rubber) molded parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears • C/R Rawhide and nylon hammers.

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Eliminating the expense of special gauge design and manufacture is an important factor in reducing production costs. To keep costs low on "special" gauge designs, USG is tooled for more than 50,000 different standard gauges. Many of these are of unique design and application. It is possible that with slight modification one or more of them will exactly meet your design requirements and save you important time and costs.

The U. S. Gauge background of over 50 years of gauge design and manufacture assures you the experience and resources that make possible an easy solution to special gauge applications.

Why not call the nearest USG Distributor or write the factory direct to determine whether we can supply a standard to your specifications, a modified standard, or whether or not your problem will actually require a completely new and special USG design. The call might save you hours in production time and a significant savings in cost.

UNITED STATES GAUGE

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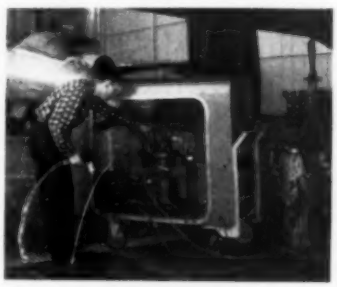
BRIEFS / continued

Hydraulically Pressurized Paint Eliminates One Coat

USAF B-57 jet bombers built by Martin are now painted one third faster by using a hot-paint airless spray unit. Paint, drawn from a standard tank, is heated to 165 degrees F and hydraulically pressurized to 600 psi. The solvents under heat and pressure, atomize the paint at the spray



nozzle, applying more paint solids to the surface being sprayed than with conventional air-spray methods. The resulting smooth high-gloss finish eliminates the usual third coating.

The design and development of the two piston power unit used on this equipment has been fully described in APPLIED HYDRAULICS Magazine, November 1955.

12 Station Drilling Machine Uses Hydraulics

A 12 station drilling machine which combines the features of an in-line transfer machine with those of a large center column rotary index machine has been designed and built by Expert Automation Machine Co. This electrically controlled, hydraulically operated unit drills, spotfaces, reams and deburrs holes in bent tubular steel automotive frames cross members at the rate of 200 pieces per hour.

Parts are loaded into the in-line transfer machine and are moved by a hydraulically operated pusher bar mechanism to the first station where five holes are drilled. At the

Continued on page 30

This ancient wayside cross has stood in the village of Meriden for some 500 years and by tradition marks the centre of England.

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

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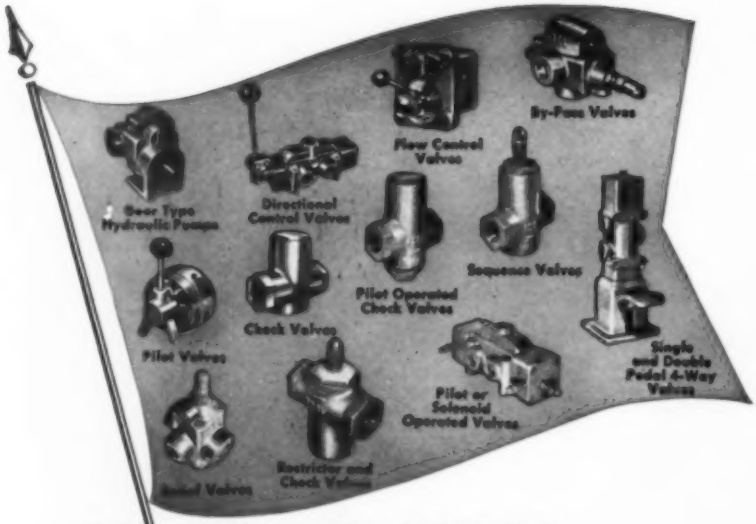
Just one mile from the centre of England, is manufactured the complete range of Keelavite quality hydraulics. Circuit design and equipment installation services engineer these products into Keelavite hydraulic power transmissions renowned throughout World industry for their reliability, performance and economy.

Canadian Agent: JOHN SPOTTON CO., LTD., 21 CARSON ST., TORONTO 14, ONTARIO



BY ANY STANDARD...

ADEL *Refinements* assure Plus Performance for Your Equipment

Designers and Engineers have set these standards for Industrial Hydraulic Equipment

Rugged simplicity • Long life • Simplification of piping • Reduced installation costs • Greater accessibility for maintenance • Completeness of line • Over-all economy

ADEL brings them all to you!

Smooth economical hydraulic power for Pushing, Pulling, Lifting, Pressing, Clamping and Controlling.

Illustrated are but a few of a wide variety of ADEL industrial hydraulic control equipment that offer definite benefits to both the user and builder of machine tools and many other kinds of equipment. ADEL products incorporate proven design and precision construction features that assure dependable operating efficiency over the years. A complete line for every application.

You can simplify your Hydraulic Power Motion Problems by specifying ADEL.

For complete engineering specifications and counsel, Address: ADEL DIVISION, GENERAL METALS CORPORATION, 10771 Van Owen Street, Burbank, California

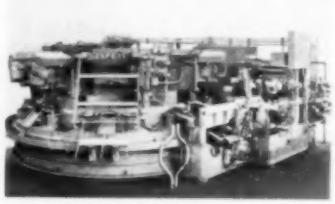
ADEL
PRECISION PRODUCTS
A DIVISION OF GENERAL METALS CORPORATION

Manufacturers of Industrial Hydraulic Control Equipment

DISTRIBUTORS: AIR-DRAULIC EQUIPMENT CO., HOUSTON, TEX. • AIR & HYDRAULIC ENGINEERING CO., NEW HAVEN, CONN. • RUSS CHAMBERLIN COMPANY, PORTLAND 14, ORE. J. BOYD COATES, GLENSIDE, PA. • CORBY SUPPLY COMPANY, ST. LOUIS, MO. • FRANK T. DONNELLY COMPANY, PITTSBURGH 38, PA. • HASKEL ENGINEERING & SUPPLY CO., GLENDALE 4, CALIF. • HASKEL ENGINEERING & SUPPLY CO., SAN FRANCISCO 7, CALIF. • AIR-DRAULICS COMPANY, PHOENIX, ARIZ. • INDUSTRIAL AIR & HYDRAULIC EQUIP. CO., DETROIT 15, MICH. LINCOLN SUPPLY COMPANY, PROVIDENCE, R. I. • L. H. MONSEES, INDEPENDENCE, MO. • THE NEFF ENGINEERING CO., FORT WAYNE 3, IND. • POWER DRIVES, INCORPORATED, BUFFALO, N. Y. • SCOTT EQUIPMENT & ENGINEERING CO., DAYTON 10, OHIO • ROBERT TAYLOR & SONS, SALT LAKE CITY 10, UTAH • WYATT SALES COMPANY, CLEVELAND 15, OHIO TRI-STATE SUPPLY COMPANY, BROOKLYN 33, N. Y.

BRIEFS continued

next station the five drilled holes are probed to check for incomplete holes due to drill breakage. Any incomplete holes cause the machine to shut down. In the fourth station a device operated by two hydraulic cylinders transfers the parts from the in-line machine to the first station of the rotary index



machine. There the parts are first clamped by a single cylinder-operated mechanism which includes an over-center mechanism and leaf-spring control that provides approximately constant clamping pressure regardless of part variations. After going through the six stations on which the various operations are performed, the parts are unloaded from the rotary index machine by another mechanism operated by two hydraulic cylinders. ▼▼▼

International Machine Tool Show

The International Machine Tool Exhibition, held every four years in London, took place from June 22—July 6. This year's exhibition displayed machine tools manufactured in the United Kingdom, the United States, and all the European industrial centers including Czechoslovakia and Hungary.

• **Tracing machines**—The trend toward automatic production in ever increasing quantities has led to the widespread use of hydraulic tracing devices, either available as machine attachments or built in as an integral part of the design. Many tracing units shown claimed very high accuracy. In the Metropolitan-Vickers Monoblock system dimensions of within 0.001 inch of the master diameter are obtainable and longitudi-

Continued on page 35

Compare actual O-ring samples

Prove by comparison tests how Parker O-rings seal better and last longer

For trouble-free leakproof sealing, you can depend on Parker O-rings. They are precision molded of superior compounds that have been developed as the result of thousands of tests.

Elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals, and high and low temperatures, are determined with care. Then, laboratory and service tests make sure that all rated characteristics are held.

From Parker you can get exactly the *right* O-ring for your *specific* application. We invite you to compare Parker O-rings with any other make. Our engineering service will also help you with designing problems.

Send for complete engineering data today. Mail the coupon for your *free* data book or ask your Parker O-ring distributor for a copy.

RUBBER PRODUCTS DIVISION
The Parker Appliance Company
17325 Euclid Ave., Cleveland 12, Ohio
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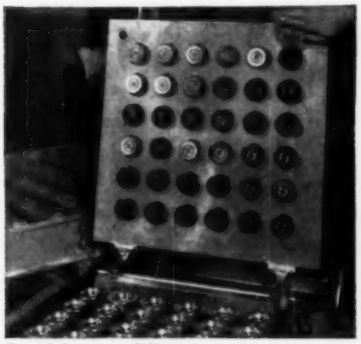
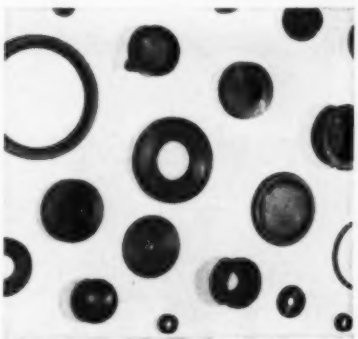
Parker

Hydraulic and fluid system components

Laboratory and service tests check compound resistance to oils, fuels and chemicals at high and low temperatures ... assuring the long life of Parker O-rings.



Precision molding by exclusive, automatically controlled methods assures close-tolerance fits. Parker has molds for 296 *standard* O-ring sizes. Send for data.



Whatever your spec on service, shape, tolerance, surface smoothness . . . one of Parker's special rubber compounds can be custom molded to meet the need.

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☐ O-ring Catalog No. 5701
☐ Custom-molded Rubber Cat. No. 5810

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COMPANY_____
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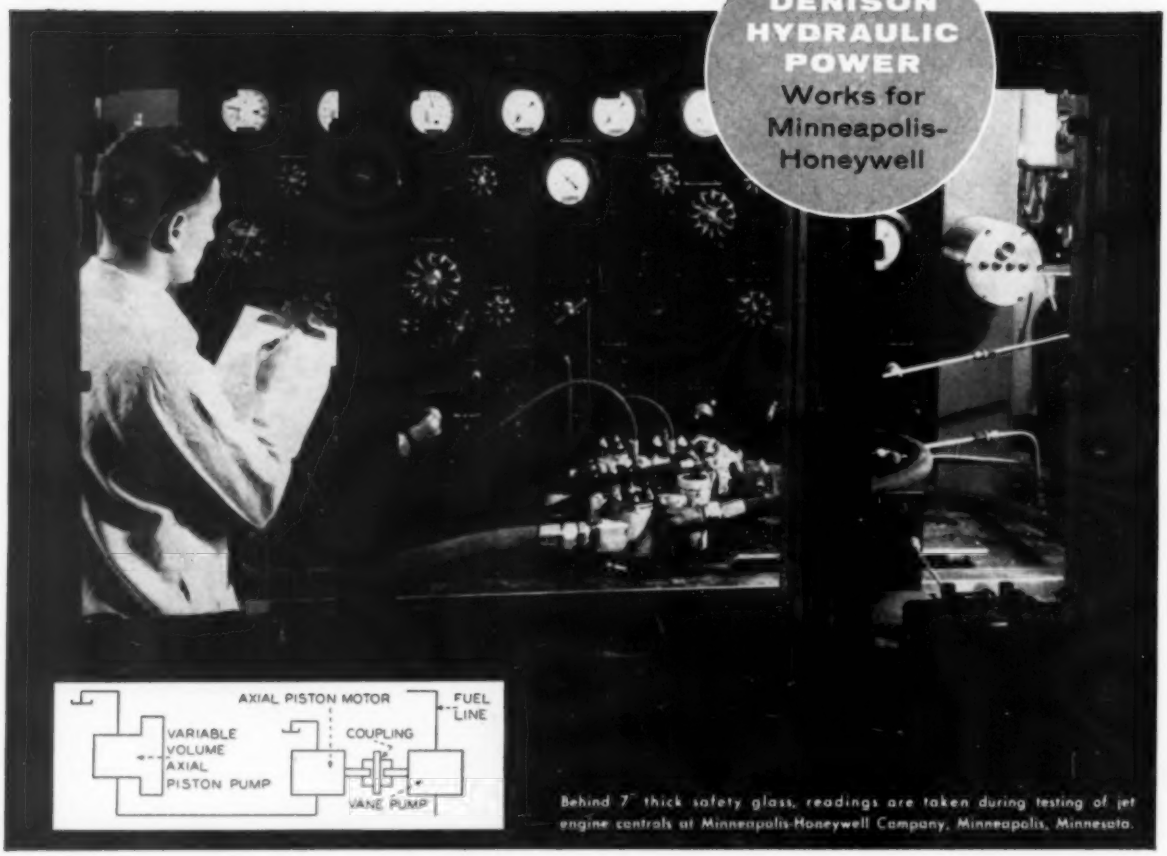
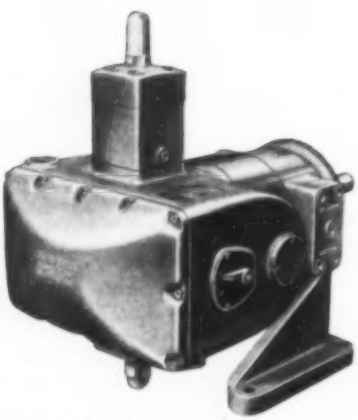
Circle 103 on Reader Service Card

How **DENISON HYDRAULIC POWER** Works for Minneapolis-Honeywell



Behind 7" thick safety glass, readings are taken during testing of jet engine controls at Minneapolis-Honeywell Company, Minneapolis, Minnesota.

Providing the muscle power for a "ghost" engine



Denison Variable Volume Axial Piston Pump remote controlled.

A unique electronic system developed by Minneapolis-Honeywell to pre-test jet engine controls now eliminates the cost of building and operating a special engine test cell. The system actually produces a more accurate record of performance than would be possible if the actual engine were used.

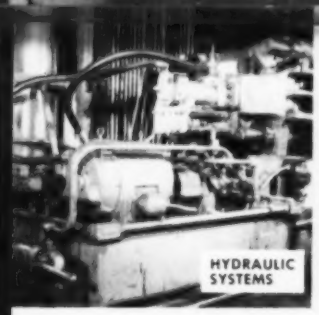
The system works this way. An analog computer takes the place of the jet engine. Performance data and other characteristics are received from the manufacturer. These are then simulated on the computer and reproduced as electrical signals, which, in turn, run the engine controls.

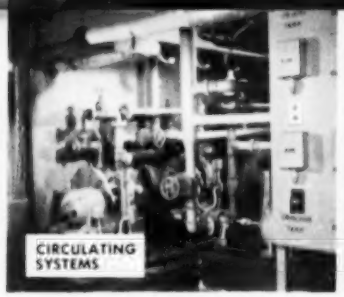
To provide dependable muscle power for this control system, Minneapolis-Honeywell relies on Denison hydraulic pumps and motors. The key unit, a Denison Variable-Volume Axial Piston Pump is the prime mover for a Denison axial piston motor that in turn powers a Denison vane pump to deliver jet fuel.

Denison hydraulic equipment is today serving all industries by cutting operating costs, speeding production, and improving reliability. Let a Denison field engineer show you how you can benefit from Denison's hydraulic experience. Write Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON HydrOILics

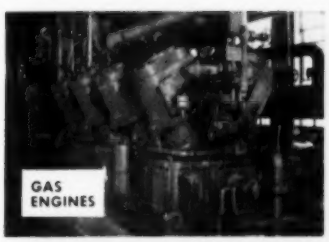


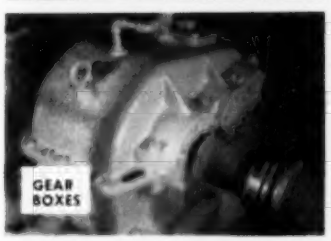


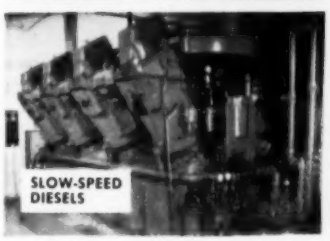
SUN SOLNUS OILS IDEAL LUBRICANTS FOR 80% OF ALL APPLICATIONS

Moderately priced...low in carbon-forming tendencies, Sun Solnus® oils simplify your storage problems by doing with *one oil* many jobs that would otherwise require *several*. Their ability to protect metal parts against corrosion, their resistance to oxidation, and their moderate price all add up to "more lubrication per dollar."

For technical information, see your Sun representative, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. I-51.







SUNOCO®

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

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Valve on left is from compressor run for 3,000 hours with well-known, high-grade oil. At right is same valve after a 3,000-hour run with Sun Solnus oil. Note difference in carbon deposits.

3000-HOUR TEST PROVES SUN SOLNUS OILS REDUCE CARBON BUILD-UP IN COMPRESSORS

Equipment: A three-stage Norwalk horizontal-type compressor. Operating pressure: from 1,000 to 1,500 psi.

Test: The compressor was cleaned thoroughly and filled with a well-known, high-grade oil. The equipment was run for 3,000 hours, then torn down for inspection and cleaning. Then Solnus® 300 was tested in the same way.

Results: Look at the two pictures. You can see for yourself how Solnus oil reduced dangerous carbon build-up.

All types of reciprocating air compressors that have been changed over to a Sun Solnus oil show similar results. A test in your compressor will show the same remarkable reduction of carbon deposits.

You can get a technical bulletin about Sun Solnus oils by asking your Sun representative, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. I-52.

SUNOCO®

INDUSTRIAL PRODUCTS DEPARTMENT

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BRIEFS / continued

nal dimensions to within 0.001 or 0.002 inch can be secured; the actual variation between the workpieces themselves is within 0.0005 inch in all dimensions in actual production, thus giving a uniformity sufficient for most normal requirements.

• **Hydraulic power packages**—Many manufacturers are meeting the demand for fluid power on machine tools by the introduction of self-contained hydraulic power packages. Keelavite Company showed a new package which embodies their gear pump to provide 0-2,000 psi pressure and 0-20 gpm delivery. The outlet connection can be coupled either to a hydraulic motor or cylinder according to whether a rotary or reciprocating motion is required. For special purpose machines where infinitely variable speed and reversible motion is needed, the Churchill-Sturm Company displayed their hydraulic drive mechanism. This consists of a self-contained unit employing a constant speed electric motor drive and oil pump which is connected to a vane type hydraulic motor. Pump and motor are contained in a common housing which serves as an oil reservoir. Efficiency of this variable speed drive is between 75 and 80 percent at full load.

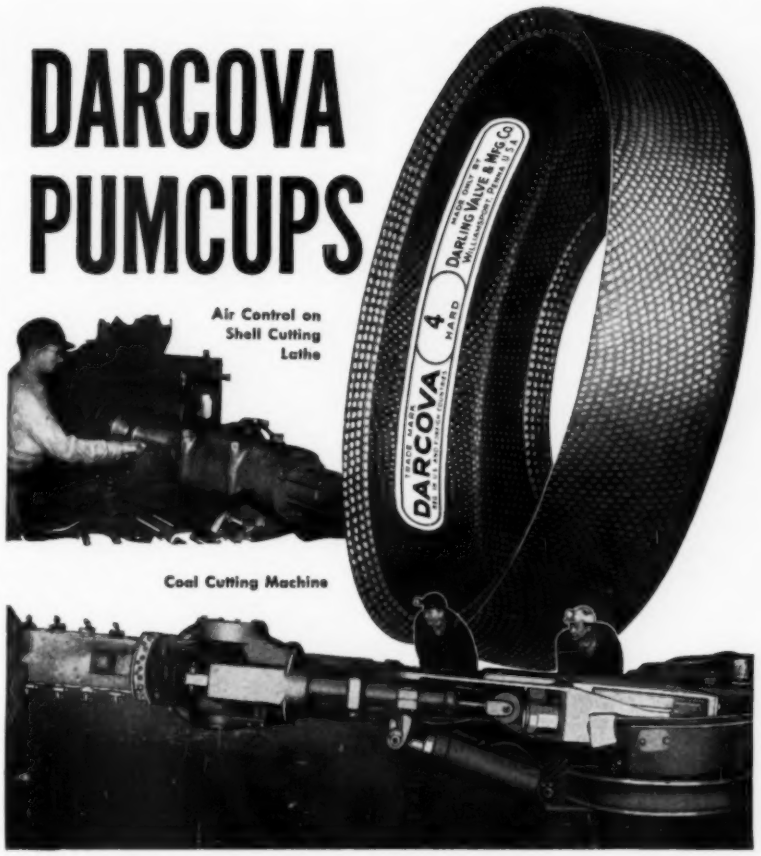
• **Pneumatics**—Compressed air, successfully used for many years on fixtures of woodworking machines, has also been adapted now for holding attachments on metal working machines. A wide range of pneumatic equipment including valves, cylinders and controls was shown by Stuart Davis Ltd.

A completely new range of pneumatic and hydraulic chucks has been developed by F. Pratt & Co. Ltd. This chucking system consists of the chuck itself, the pneumatic or hydraulic rotating cylinder, and a power package carrying the pump or pumps, and control valves, which can be either manually or solenoid actuated.

• **High speed grinding spindles**—Both air and oil power are currently used to drive high speed

Continued on page 38

DARCOVA PUMCUPS



Air Control on Shell Cutting Lathe

Coal Cutting Machine

The most efficient piston packing for air and hydraulic mechanisms

MORE and more plants are adopting Darcova Pumcups as the standard packing for air and hydraulic cylinders in machine tools, presses, hoists, lifts, rams, pusher mechanisms, controls, regulator valves, spraying equipment and various types of machinery . . . using air, oil, water and other fluids.

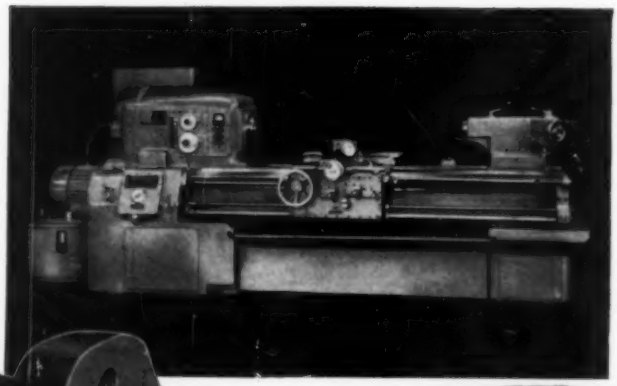
There are two basic reasons why Darcova Pumcups have proved to be more efficient: (1) Texture engineered Pumcups outlast most other piston packing at least 3 to 1. (2) Pumcups operate at full efficiency *throughout* their entire life span.

Fewer shutdowns, lower operating costs and longer cylinder life . . . are some of the advantages of Darcova Pumcups. Send for all the facts. Write for Bulletin No. 4502 on Pumcups for air and hydraulic mechanisms.

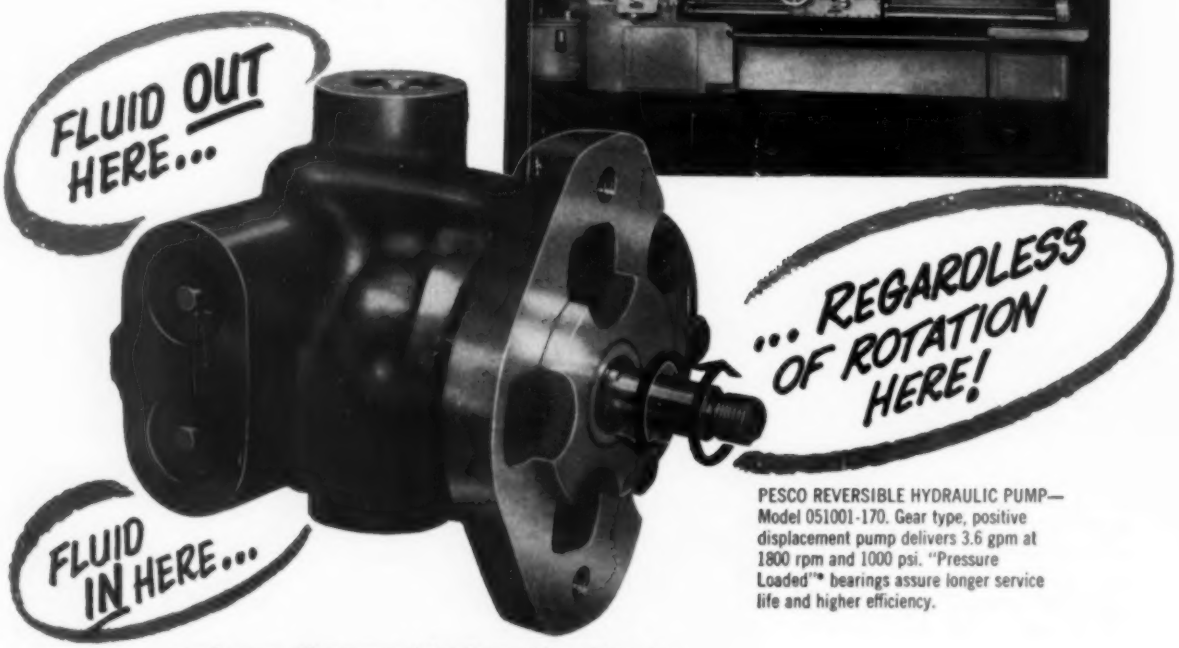
DARCOVA
THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

PUMCUPS



USED ON MONARCH LATHES—The Monarch Machine Tool Co. uses a Pesco Reversible Pump to provide hydraulic power on its Series 62 and 80 lathes for headstock shifting and four-way power rapid traverse, and on the Series 90 lathes for head-stock shifting. Pump is belt driven by main drive motor (left).



PESCO REVERSIBLE HYDRAULIC PUMP—Model 051001-170. Gear type, positive displacement pump delivers 3.6 gpm at 1800 rpm and 1000 psi. "Pressure Loaded"* bearings assure longer service life and higher efficiency.

unique Pesco Hydraulic Pump has

one-way flow... regardless of rotation!

No matter which way you rotate this new PESCO Hydraulic Pump, flow is always in the same direction—inlet and outlet ports do not change! Startling? Yes . . . but it is typical of the valuable contributions now resulting from PESCO's creative engineering.

This PESCO pump is the answer for applications having a dual rotation power source, but requiring single direction hydraulic flow. On machine tools, for example, it can be run off the main drive motor to provide constant hydraulic power regardless of rotation. And for power take-offs on trucks and tractors, this pump gives correct flow independent of rotation.

Where can you use this pump? Samples are in stock and available to original equipment manufacturers for testing. Production requirements can be met promptly. For detailed information or specifications, contact your nearest PESCO sales engineer, or write: PESCO, 24700 North Miles Road, Bedford, Ohio.

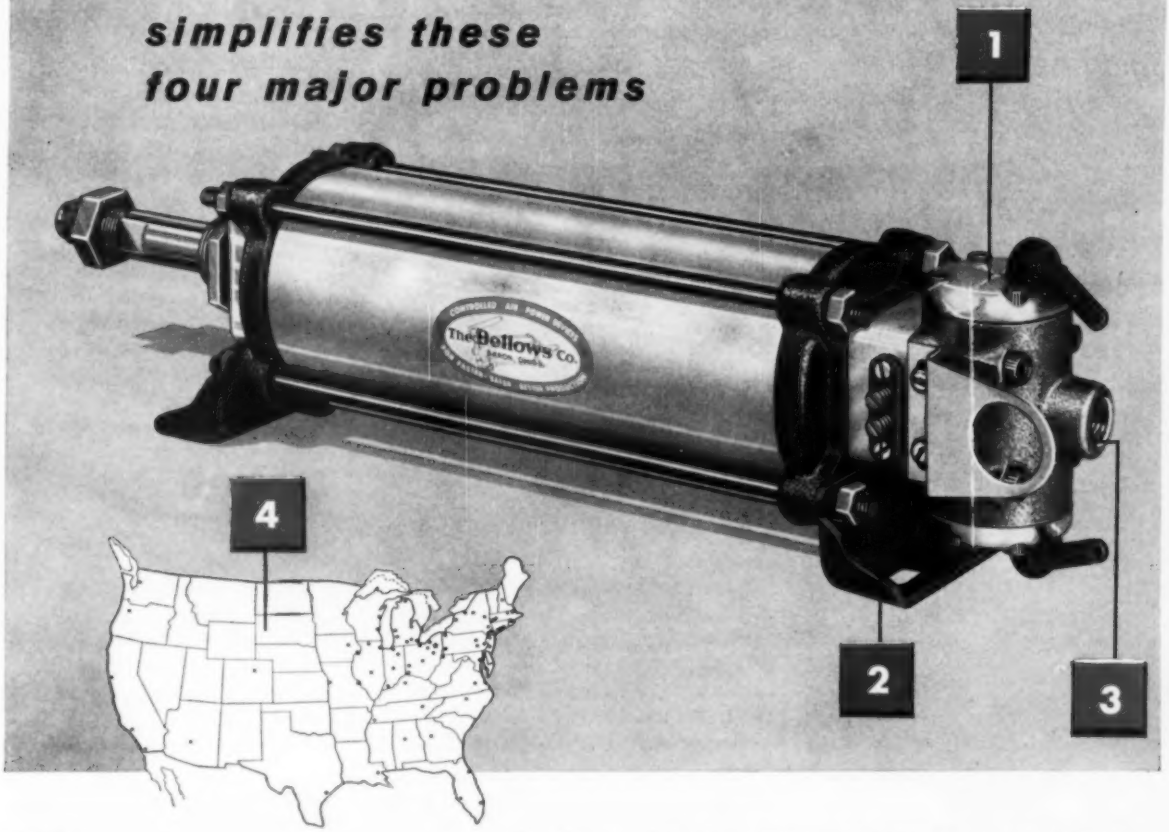
*PESCO's patented principle of gear pump construction

PESCO PRODUCTS DIVISION
BORG-WARNER CORPORATION
24700 NORTH MILES ROAD • BEDFORD, OHIO

Producing the Best in Hydraulic Pumps, Fuel Pumps, Electric Motors and Axial Flow Blowers

THE Bellows AIR MOTOR

simplifies these four major problems



1 **Built-in electrically controlled directional valve, either 8 or 110 v., simplifies design problems.**

2 **Built-in speed controls for accurate regulation of piston rod speed simplify control problems.**

3 **The single air connection, which can be made with flexible air hose, simplifies installation problems.**

4 **More than 125 Bellows Field Engineers in the United States and Canada simplify service problems.**

Design, control, installation and service are problems every O.E.M. Design Engineer faces when selecting components for automation.

In pneumatic design, the Bellows Air Motor—the air cylinder with the built-in valve—simplifies his problems. Instead of separate valving for directional control, separate valving for speed control, multiple mounting, complex and cumbersome piping for air supply—he works with one compact, complete power unit.

Not only are design and control simplified when you specify "Bellows", but installation costs are less; and you know wherever your machine is shipped, a Bellows Field Engineer will be available for service if it is ever needed.

Write for Bulletin BM-25
"The Story of The Bellows Air Motor"
Address: Dept. AH-1056
The Bellows Co., Akron 9, Ohio

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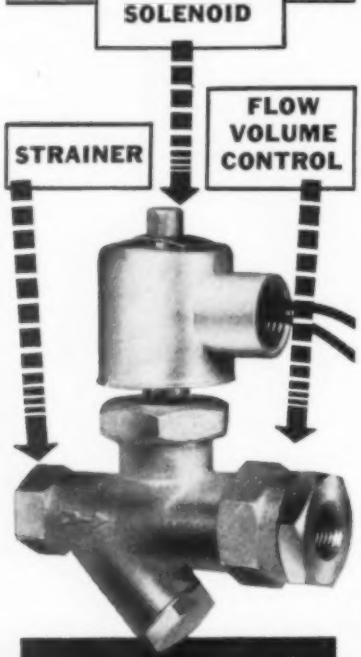
In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ont.

6448

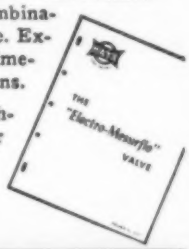
A COMPLETE PACKAGE



"ELECTRO-MESURFLO" VALVE

A compact "package" consisting of basket-designed inlet strainer, patented automatic flow rate control and electric valve—at economic product cost. For water—can be used on air. An infinite variety of combinations available. Excellent for time-fill applications.

Write for technical folder #217.



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INDUSTRIAL SALES DIVISION

HAYS MFG. COMPANY

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BRIEFS continued

grinding spindles. The Offen-Reilly spindle is driven by oil power and the important feature of the attachment is the hydraulic bearing which permits rotational speeds as high as 140,000 rpm to be achieved with extreme accuracy of positioning of the grinding wheel. A Swedish high speed spindle was exhibited by Fenter Machine Tool Co. Ltd., this example being of the air powered turbine variety. The speed range is infinitely variable between 60,000 and 100,000 rpm. J.A.L. ▼▼▼

More In-Plant Hydraulic Education

To familiarize their own plant personnel with the every day problems of hydraulics, The Dow Chemical Company's Midland Division offers a hydraulic training course. Conducted by Carl Shafer of the maintenance education department, the course is divided into twenty sessions of two hours each.

• **Course outline**—Subjects covered are principles of power hydraulics; color code and JIC symbols; strainers and filters; hydraulic plumbing; introduction to pumps and valves; hydraulic motors. Each subject is discussed as to classification, installation, operation and selection. During the later stages of the course, sessions are devoted to the reading of circuits. To supplement classroom theory and field training, the company is in the process of setting up a hydraulics laboratory.

• **Reference material**—To aid in the teaching of hydraulics, students are required to read recommended text books and magazine articles on industrial hydraulics, operation and care of hydraulic machinery, and catalogs and maintenance manuals from various manufacturers. ▼▼▼

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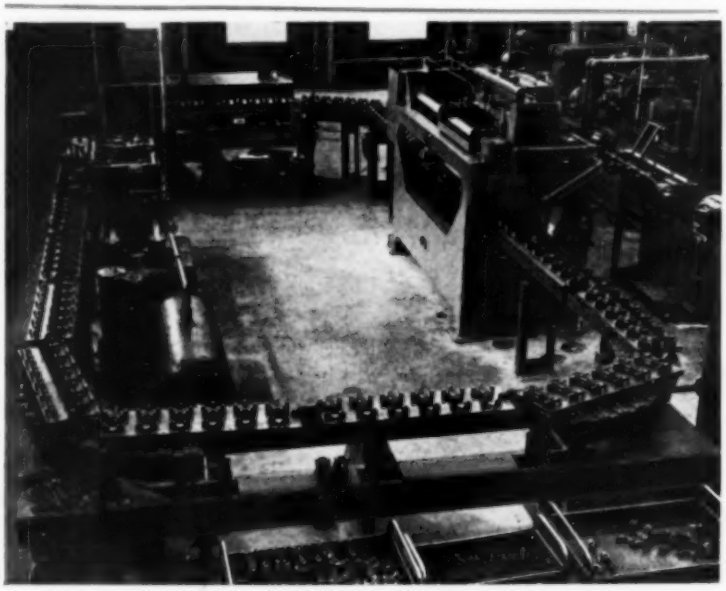
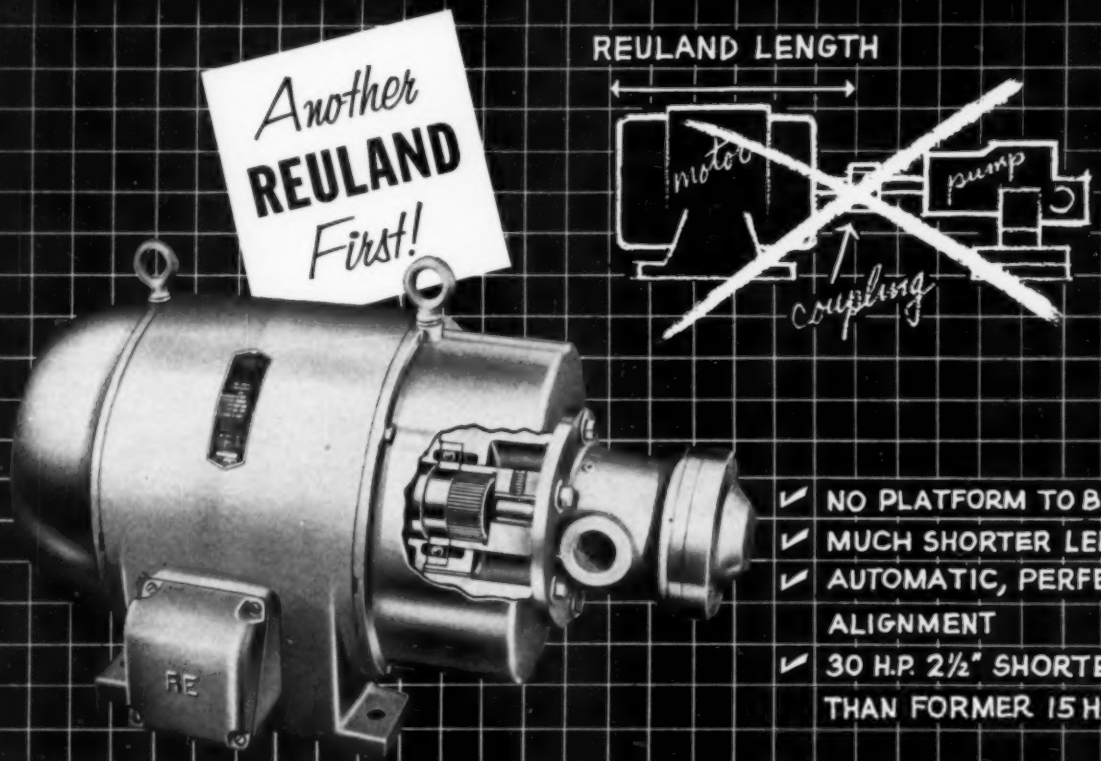


This fully automatic assembly system which bolts bearing caps in place on automobile engine connecting rods has been built by Cleco Air Tools, a division of the Reed Roller Bit Company. The bolt-press unit is electro-hydraulically powered, the nut-setting unit is electro-pneumatically powered. The machine has a capacity of 2000 connecting rods per hour. Nut setting unit, shown at left, is powered by standard air motors.

Another REULAND First!



- ✓ NO PLATFORM TO BUILD
- ✓ MUCH SHORTER LENGTH
- ✓ AUTOMATIC, PERFECT ALIGNMENT
- ✓ 30 H.P. 2½" SHORTER THAN FORMER 15 H.P. MODEL

NEW, REULAND HYDRAULIC PUMP MOTOR features FAST, SPLINE-COUPLED hook-up!

Perfect alignment ...in 1/10th ordinary time

You can hook up a Reuland motor and any standard make hydraulic pump in a matter of only seconds. All you have to do is slip the spline coupling onto the motor's spline shaft and attach the pump flange to the endbell.

Absolutely perfect alignment is assured. There is no tinkering around with a mounting platform and your finished job always has a sleek, well-designed appearance. Takes only a tiny fraction of the ordinary time.

For all standard pumps

Regardless of the pump you are now using, you can adopt this exclusive new Reuland hook-up.

If your pump is not a standard make we can quickly adapt to your setup. The Reuland method is so radically simple you will be amazed at the tremendous advantages.

Coupling supplied with motor

Buy a Reuland hydraulic pump motor and you need nothing more. Spline coupling and drilled-and-tapped endbell are supplied ready for immediate pump attachment. (Adaptable to either single or double end pump installations.)

Use these new Reuland motors and you will save platform mounting expense and alignment time. You achieve compactness and better looks *plus* longer pump life through factory engineered alignment. For FREE ENGINEERING LITERATURE please write for folder No. 1109.

Other Reuland firsts...

- MOTOR WITH INTERNAL FLUID COUPLING
- ALL-ALUMINUM MOTOR FRAMES
- "THROUGH-SHAFT" MAGNETIC DISC BRAKES
- FOOT MOUNTED MAGNETIC DISC BRAKE COMPLETE WITH BEARINGS AND SHAFT
- PRECISION MOTORS FOR MACHINE TOOLS

REULAND MOTORS

REULAND ELECTRIC COMPANY

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Don't pay for special-motor development before you check Reuland's

Special-Motor Library

Hundreds of different and unique electric motors — one of which may already be made to order for your needs. Originally designed for special uses. Now available to help you save expensive development work and put you in production faster!

Write for free booklet on HOW TO USE the Reuland Library!

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your best bet is

FLEX-O-TUBE

Supplied in Assemblies

Flex-O-Tube will help you determine the assembly needed or work to your own specifications. In either case, modern facilities and latest inspection techniques assure you a uniformly high quality product delivered promptly.

Supplied for Field Assembly

Flex-O-Tube hose is also supplied in bulk coils with reusable fittings for field assembly. Complete range of sizes and types.

Any way you look at it, when the pressure's on, your best bet is Flex-O-Tube. That's because Flex-O-Tube stands for a dependable product, delivered promptly and uniform high quality.

When the pressure's on for production, aircraft men know that Flex-O-Tube deliveries are dependable . . . they know, too, that Flex-O-Tube stands for uniform high quality. And that's mighty important when tight schedules must be met and every hose assembly counts.

Aircraft engineers can relieve the pressure, too, by calling on Flex-O-Tube's broad experience in determining designs of new hose assemblies.

And in the air, where it really counts, Flex-O-Tube is a top performer under pressure. Miles and miles of Flex-O-Tube used in all types of aircraft have proven this beyond question.

Why not call in Flex-O-Tube on your requirements . . . you can rely on the product —you can rely on the service.

Complete Line **OF BULK HOSE, ASSEMBLIES AND FITTINGS FOR LOW, MEDIUM AND HIGH PRESSURE USE**

AUTOMOTIVE—Fuel, Oil, Filter, Brake and Window Lift Lines, Air Conditioning and Power Steering Hose Assemblies

AIRCRAFT—Low, Medium and High Pressure Hose Assemblies, Bulk Hose and Reusable Hose Fittings, Oxygen Hose Assemblies

INDUSTRIAL—Complete line of crimped and reusable fittings and hose assemblies for low, medium and high pressure uses

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SPECIAL FITTINGS—Custom made to your design or developed for special applications

TEFLON® HOSE—And Hose Assemblies for use from —100°F to 450°F

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BRIEFS continued

Hydraulic Truck Crane Weighs Only 100 LBS

A hand operated hydraulic crane, of quarter-ton capacity, which can be mounted on the smallest capacity trucks has been manufactured by Ruger Equipment Inc. The crane rotates a full circle and can be locked at any of 12 positions.

The self-contained hydraulic unit consists of a pump, lifting cylinder, release valve and overload relief valve which is set at 700 psi.

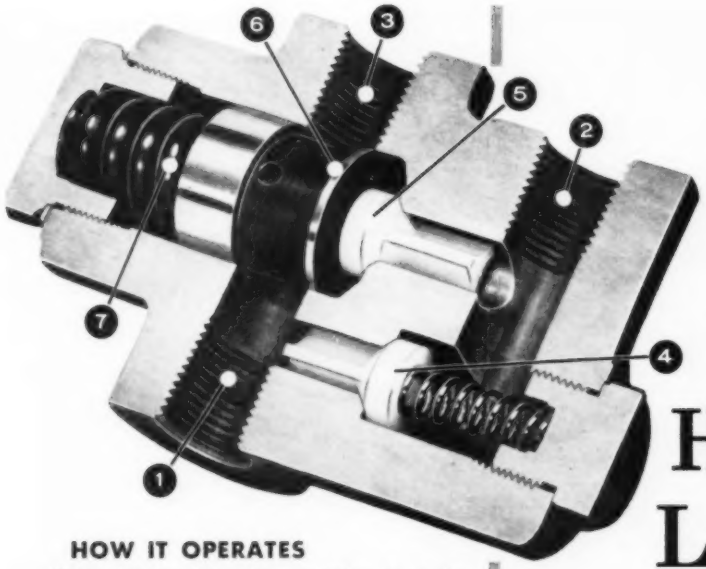
The crane offers a vertical travel of 68 inches. The mast rotates in its well on a roller bearing and is braced by two graphite-impregnated bushings, insuring that the boom can be swung as easily loaded as unloaded. ▼▼▼

Precision Grinding Machine Uses Air Motor

Adaptation of a high speed, precision, machine tool type air motor as a chuck holder for a standard grinding point in the Glenn L. Martin Company's Baltimore plant, has resulted in increased production in the grinding of cam follower surfaces.

Use of the 65,000 rpm air motor, mounted on a Deckel die sinking machine, made it possible to use the machine to finish grind the

Continued on page 42



NEW Webster Hydraulic Lock Valve

PROVIDES POSITIVE LOCK OF LOADED HYDRAULIC CYLINDERS UNTIL FLOW IS DELIBERATELY REVERSED . . . PREVENTS GRADUAL DROPPING

• WEBSTER'S new Model WV Hydraulic Lock Valve has been designed to eliminate a common fault in many hydraulic systems—the gradual dropping of loaded cylinders due to seepage of fluid around the spool of a standard hydraulic directional valve.

This new lock valve is particularly important on equipment like road building machinery, agricultural equipment, materials handling equipment and other lifting applications. It has a capacity of up to 20 gpm, at pressures up to 1500 psi.

HOW IT OPERATES

When the load bearing cylinder is to be raised, the directional valve is moved into the raised position and oil flows into either port **1** or **3** of the lock valve. (The port not used may be plugged or used for a pressure gauge.) Port **2** is connected to one end of the double-acting cylinder which will move the load.

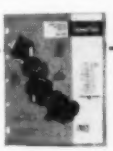
The oil flowing into port **1** or **3** opens nylon check valve **4**. The spring behind this valve is very lightly loaded. The oil flows through the spool and out port **2** into the cylinder, raising the load.

When the directional valve is put into neutral position, valve **4** closes instantly, preventing the oil from returning through port **2**, and therefore locking the lifting mechanism into place. To lower the load, oil is applied to the other end of the double-acting cylinder, forcing oil back into port **2**.

In order to discharge the oil back to the directional valve through either ports **1** or **3**, it is necessary to open nylon valve **5**. This valve is held by piston **6** and the loaded spring **7**.

Loads on this spring may be varied at the factory—a typical load being 1200 psi.

The instant the valve is opened pressure is exerted against the large area of piston **6** and the pressure required to hold the valve open is reduced to below 150 psi. This design feature eliminates the necessity of applying high load during the entire lowering stroke.



Write today for complete information

☐ Please send us complete information on WEBSTER'S WV Lock Valve

☐ Please send catalog on complete WEBSTER line

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MANUFACTURERS OF A COMPLETE LINE OF OIL HYDRAULIC PUMPS FROM 1/5 TO 30 GPM CAPACITY

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★ DESIGNED FOR EVERY PISTON AND ROD
POLYMER SATURATED FABRIC ★ PRECISION TRIMMING
★ PROPER INTERFERENCE FOR AUTOMATIC SEALING

PLUS ROCK-HARD ADAPTERS
TO PREVENT EXTRUSION, RESIST HIGH PRESSURES

Raybestos-Manhattan combines top-flight design engineering with superior molding techniques. The result is an outstanding packing—in this case America's most copied packing. Whatever your hydraulic application, you can count on getting perfect performance from this self-sealing, self-adjusting packing—even at pressures in excess of 6000 psi.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS

R/M's line of molded hydraulic and pneumatic packings includes:

VEE-FLEX PACKINGS
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FABRIC PISTON CUPS

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PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

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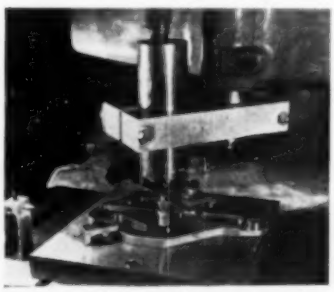
BRIEFS continued

spoiler mechanism cams on the TM-61 Matador. 100 psi pressure is regulated by a globe valve and pressure meter. The die sinking machine is operated manually.

The use of a hand finished cam as a pattern and setting the machine for a tracing ratio of one to



one, actual grinding of the wing spoiler cams is done at about 35,000 rpm on high speed carbon steel. No supplementary tooling for holding the pattern or the parts is necessary. ▼▼▼

Heavy Duty Portable Hydraulic Power

Many construction jobs using heavy duty, single-acting jacks need a portable source of hydraulic power. Builders of large presses also require a power source to be used for test and set-up purposes during erection. Design of a

power unit for such applications was carried out by Hydro-Tite Co., Milwaukee. Careful consideration was given to cost, weight and flexibility.

The final design provides two power sources for driving the pump—a single cylinder air cooled 4-cycle gas engine and a 5 hp, 220/440 volt electric motor.

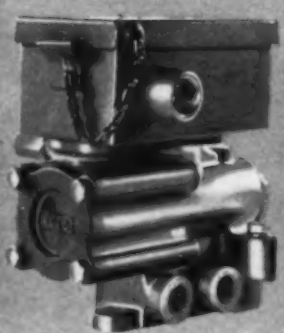
A variable volume, pressure compensated, vane pump supplies

Continued on page 46

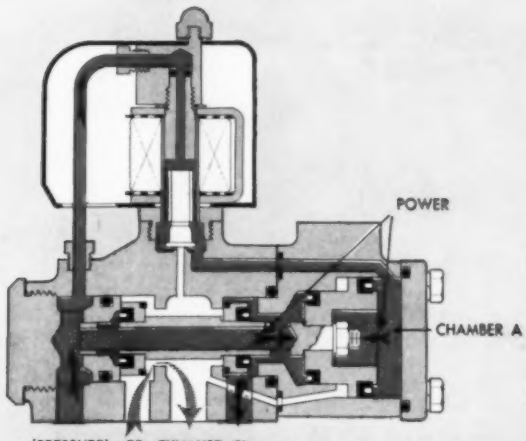
Now available: full line of ASCO 4-way solenoid valves

Single Solenoid: operates when solenoid is energized; returns automatically when de-energized.

Dual Solenoid: operates when either solenoid is energized; will not return until opposite solenoid is energized. Solenoids may be energized continuously or momentarily.



J.I.C. Construction: single and dual solenoids, with sub-plate mounting.



power driven in both directions by line pressure

Now available in ⅜" through 1" sizes, these valves are positive in action. When the solenoid is de-energized, *line pressure* applied to the top of the pilot core forces it off the seat, eliminating possible sticking caused by residual magnetism. *Line pressure* is applied to Chamber A, moving the piston-disc assembly to the left. When the solenoid is energized, Chamber A is exhausted and *line pressure* drives the piston to the right.

absolutely tight seating — no leakage

Combination of metal to metal and resilient seating provides dead tight shut-off — even on air. No grinding, lapping or close adjustments are necessary.

Available in standard, watertight or explosion-proof solenoid enclosures, the Bulletin 8344 permits cycling rates to 850 per minute — mounted in any position. Design simplicity eliminates maintenance problems.

J.I.C. construction available

These 4 way valves are available in all sizes to meet J.I.C. (Joint Industry Conference) standards. Valves are provided with sub-plates, vapor-proof solenoid enclosures, and manual overrides, and are electrically inoperative when the cover is removed.

New ASCO Condensed Valve Catalog No. 201 is now available. Write today for this basic reference on solenoid valves.

Important announcement . . . *new ASCO plant now being built in Florham Park, N. J., will double production capacity and greatly extend the range of our research, product development and services.*

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SOLENOID VALVES ELECTROMAGNETIC CONTROL

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DROP FORGED STEEL VALVES and FITTINGS

Modern die casting machine operation involves the use of standard hydraulic oils as well as special non-inflammable oils which must be safely and positively controlled at pressures from 800 pounds up to 4000 pounds per square inch.

Vogt drop forged steel valves, fittings, flanges and unions are unsurpassed for these rigorous duties and are standard equipment on the leading makes of die casting machines.

Consult Catalog F-9 for the complete line of Drop Forged Steel Valves, Fittings and Flanges.

"FIRST CHOICE OF THE LEADING MAKERS OF DIE CASTING MACHINES"

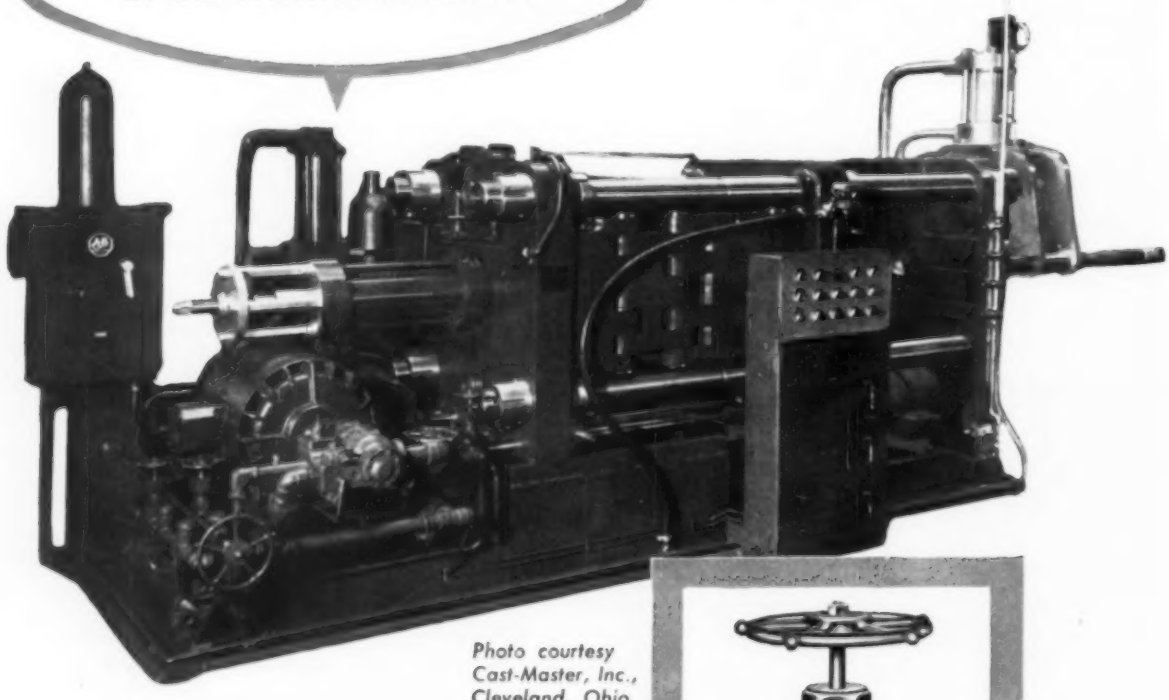

Photo courtesy Cast-Master, Inc., Cleveland, Ohio

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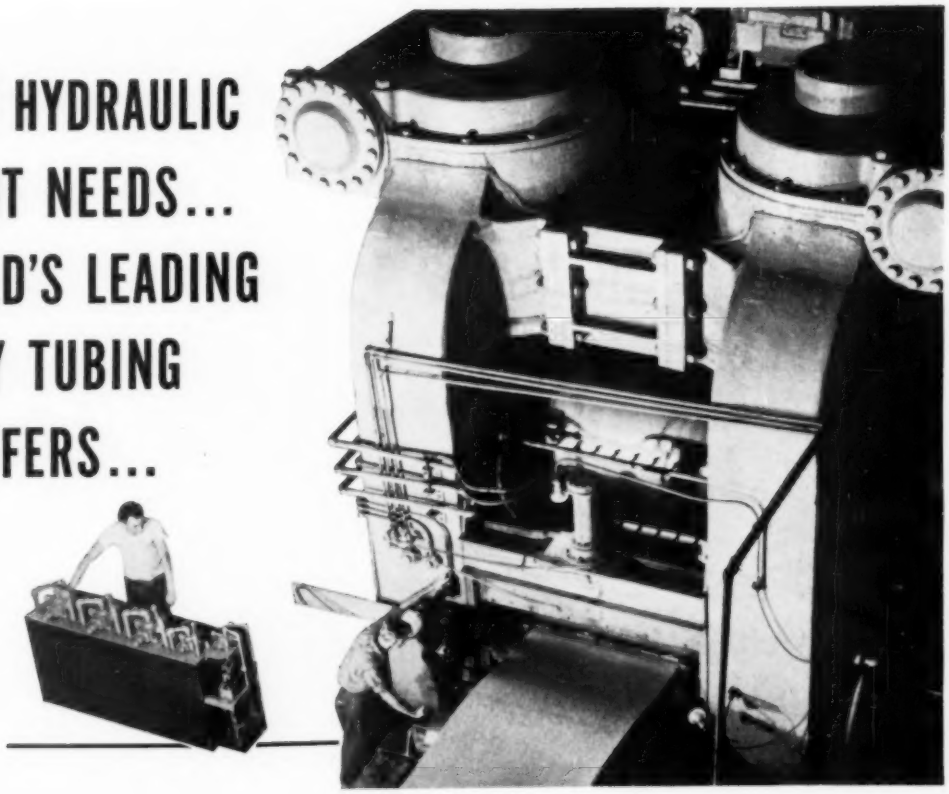
Drop Forged Steel Valves, Fittings and Flanges in a complete range of sizes • Petroleum Refinery and Chemical Plant Equipment • Steam Generators • Heat Exchangers • Ice Making & Refrigerating Equipment

FOR YOUR HYDRAULIC EQUIPMENT NEEDS... THE WORLD'S LEADING SPECIALTY TUBING MAKER OFFERS...



Republic ELECTRUNITE® Steel Hydraulic Line Tubing

Republic is now producing an electric welded steel hydraulic line tubing to a highly restrictive specification that will assure unsurpassed performance in your high-pressure applications.

This specification is the result of knowledge gained in the manufacture of critical ammunition components used in Korea. The excellent performance of our welded tubing throughout this period proved beyond a doubt its complete dependability.

In addition to serviceability, Republic ELECTRUNITE Hydraulic Line Tubing includes other important advantages. Because the tube is formed from flat rolled steel, both inside and outside surfaces can be checked for defects. The resulting uniform wall of the tube coupled with high ductility provides excellent flaring and bending characteristics. And the tube is not subject to longitudinal and transverse cracks.

It will pay you to get *all* the facts on Republic ELECTRUNITE Hydraulic Line Tubing. You'll discover how it can substantially reduce maintenance costs in complicated installations. It's available in a wide range of sizes and in wall thicknesses regularly used in hydraulic applications. Fits all standard fittings and accessories. Send coupon for additional information.

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World's Widest Range of Standard Steels and Steel Products

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There's safety in these NEW numbers

UCON BRAND Hydrolube 150-CP

(Viscosity—approx. 150 S.U.S. at 100° F.)

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Yes, there's safety in these two new grades of UCON Hydrolubes —CARBIDE's safety hydraulic fluids.

Greater safety for machines

These new UCON "CP" Hydrolubes...

- Contain improved liquid and vapor phase corrosion inhibitors for the common metals.
- Have good lubricity. Special anti-wear agents provide improved pump life and performance characteristics.
- Have high viscosity indexes—150 to 160.
- Have low pour points—can be used at sub-zero temperatures.
- Have no harmful effects on packings and seals. Leakage losses are often lower than with other hydraulic fluids.
- And, are made in the two standard viscosity grades—others can be supplied to fit specific requirements.

Safety for men and property

- The resistance of UCON Hydrolubes to burning has been proved by years of exhaustive testing in the laboratory and, by more than 8 years of practical application under standard industrial conditions. UCON Hydrolubes are water-base hydraulic fluids—the water content is the key to their fire-resistance.
- And, for all practical hydraulic purposes, UCON Hydrolubes are non-toxic to workmen.

For safety's sake, get all the facts. Write *today* for the new booklet, "UCON Hydrolubes Spell Safety," Form 40134.

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BRIEFS continued

oil through a 7 to 1 intensifier to a manifold from which up to four jacks can be operated.

An unusual feature of this portable unit is the evacuator which develops a vacuum in the manifold when the directional valve is shifted to allow the single-acting jacks to lower. Since the high pressure hose to the jack is usually not more than ¼ inch diameter, it is very desirable to apply a vacuum to the hose line to induce the oil to return to the reservoir. ▼▼▼

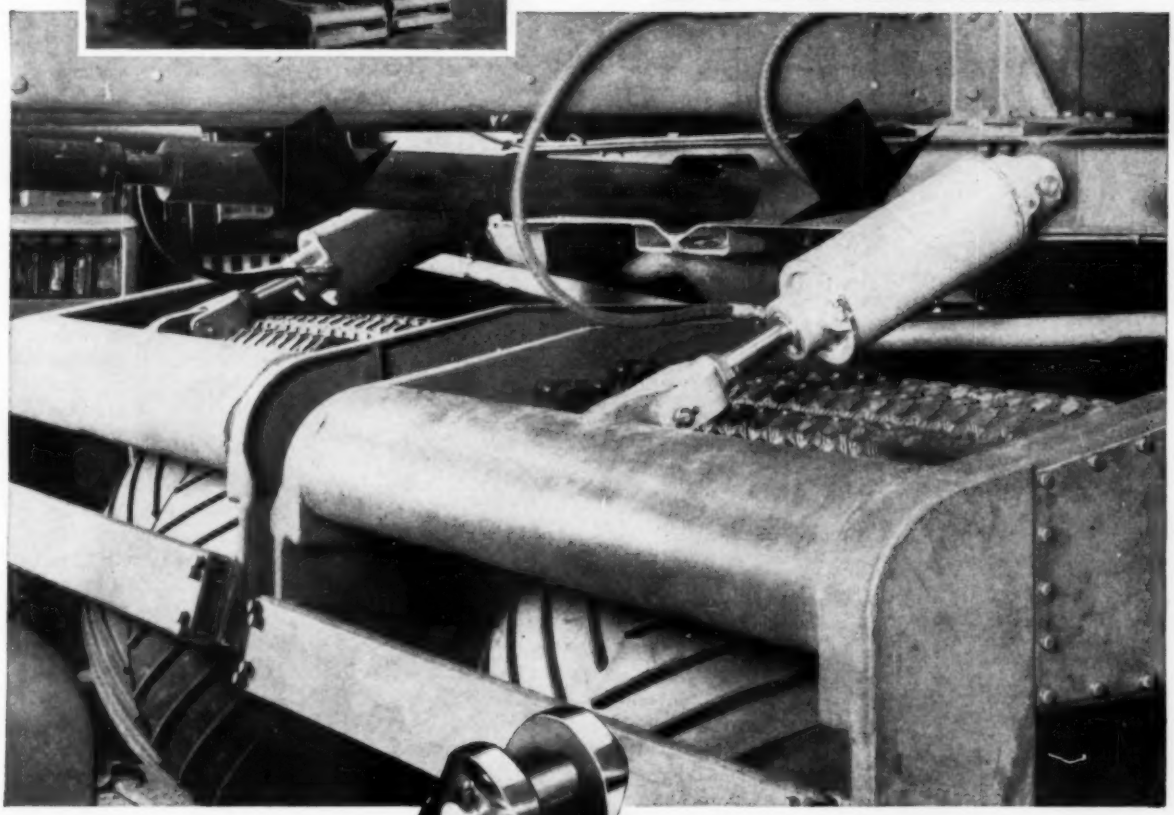
A new hydraulically operated concrete and masonry drilling machine—Model V Mole—has been developed by Molco Drilling Machines, Inc. A compact hydraulic system feeds the drill bit into the work surface automatically. Holes from 1" to 14" diameter can be easily cut. The machine also incorporates a swivel head which permits holes to be drilled at any angle. Special diamond faced self-sharpening core bits drill through reinforced concrete and other hard building materials at speeds faster than any other method.

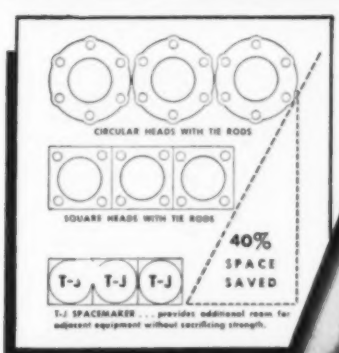
Hydraulic Cylinder Operates Automatic Rail Clamp

Development of self-adjusting automatic rail clamp which permits a clamping force to be applied directly by a hydraulic cylinder when the structure is in motion, has provided a number of

Continued on page 48

Arctic Cargo Carrier Depends On T-J *Spacemaker* CYLINDERS




CIRCULAR HEADS WITH TIE RODS
SQUARE HEADS WITH TIE RODS
40% SPACE SAVED
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T-J SPACEMAKER . . . provides additional room for adjacent equipment without sacrificing strength.

Saves 40% Space!
No Tie Rods For Greater Strength

Differential axle loading through T-J Spacemaker Air Cylinders forms a controlled walking beam in this Teracruiser, designed and produced for the Army Ordnance Corps by the Four Wheel Drive Co., Clintonville, Wis.

Weight of cylinders was important factor in choosing T-J Spacemakers, which reduce weight while providing same displacement and extra high safety factor. Fast delivery and space-saving features also favored T-J. Exclusive with T-J are new Super Cushion Flexible Seals for Air (to 200 P.S.I.) . . . and New Self-Aligning Master Cushion for Oil (to 750 P.S.I.). Hard chrome plated bodies and piston rods are standard, at no extra cost. Wide range of styles, capacities . . . 64,000 combinations *off the shelf!* Write for bulletin SM-155-3. The Tomkins-Johnson Co., Jackson, Mich.

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Magnetic Separators

remove ferrous grit (rust, core sand, metal worn off moving parts) which circulates in the hydraulic system. Remove these particles to eliminate scoring and abrasive wear, leakage, sticking and non-functioning of valves, pistons and pumps.

Frantz FERROFILTERS increase overall efficiency—and once installed, you can forget them except for infrequent cleaning. They have no moving parts; no cartridges to replace. For complete information

Send for BULLETIN PM-65

Full data on how FERROFILTERS are made and operate; installation and application; sizes, dimensions and capacities.

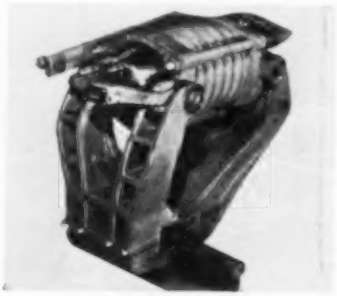
S. G. FRANTZ CO., Inc.

Brunswick Pike & Kline Ave.
P. O. Box 1138 Trenton 6, N. J.

BRIEFS continued

safety and operating advantages previously unavailable.

A compression-type spring works directly on the clamp jaws to apply pressure through serrated shoes to the rail head. Clamp is released by oil pressure to the hydraulic cylinder which applies



force to compress the spring. The pump motor is wired through the propelling master and operates in conjunction with it. Placing the propelling master on the first point in either direction actuates the clamp pump motor and hydraulically releases the clamp in from 3 to 5 seconds. Thus the propelling circuit is established through relays by the rail clamp limit switch. Unit is held open as long as the propelling master is in the off position. When the propelling master is put in the off position, the pump motor automatically stops a solenoid bypass valve opens, relieving the hydraulic cylinder, and the rail clamps grip the rail.

The clamp, made by the Mead-Morrison Division of McKiernan-Terry Corp., is made to fail safe. Any hydraulic or electrical system failure cuts the propelling circuit and the structure cannot be moved until failure is corrected. ▼▼▼

Film List

A new 24 page booklet published by the National Machine Tool Builders' Association, lists 123 motion pictures on machine tools and machining operations. The films have been prepared for training or sales purposes and are mostly concerned with specific machining operations.

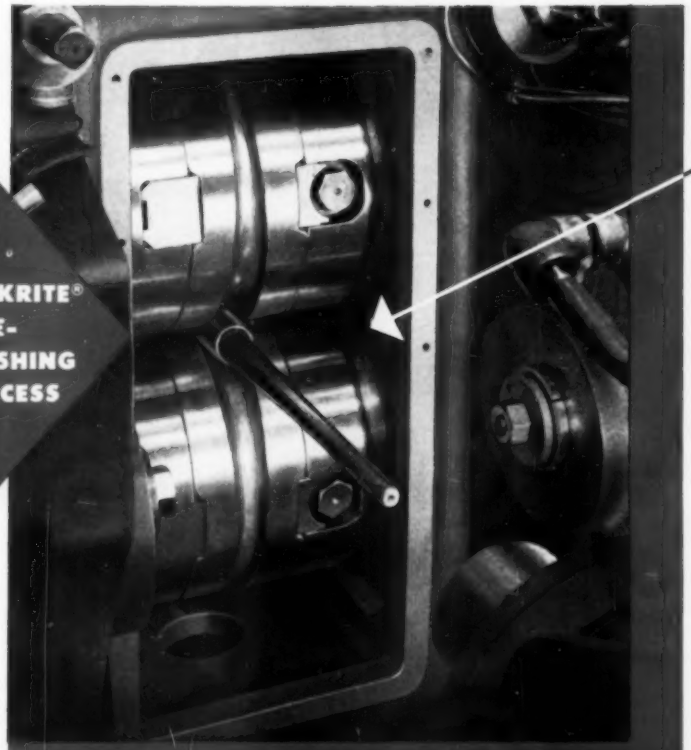
With few exceptions all films are 16 mm with sound; 79 are in color and the average showing time is 30 minutes.

Copies of the new booklet are available from the National Machine Tool Builders' Assoc., 2071 East 102nd Street, Cleveland 6, Ohio. ▼▼▼

Continued on page 50

1,000,000th Valve

Andrew B. Huntington, chief engineer of Ross Operating Valve Co., is displaying his firm's one millionth valve to R. J. Cameron, president (right). Ross Valve—now marking 35 years in business—gold plated this air control valve. Cameron stated, "Industrial use of air power has doubled about every five years since 1921 when Charles A. Ross formed the company to produce a hand-operated valve he invented. This five year rate of increase can be expected to continue for at least another decade."

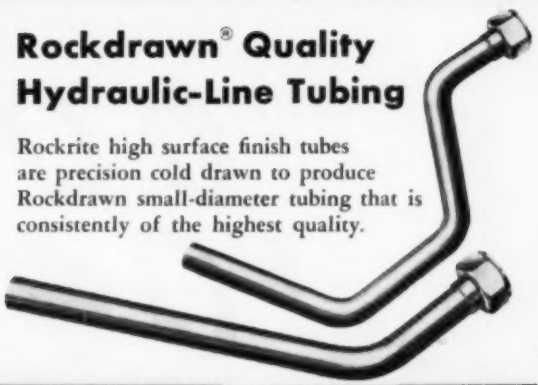


High quality begins here

This tube, leaving the Rockrite reducer, has been cold compression rolled—with great metal displacement. Result: Better structure of the metal, precision dimensions, and excellent surface finish. It is a quality tube.

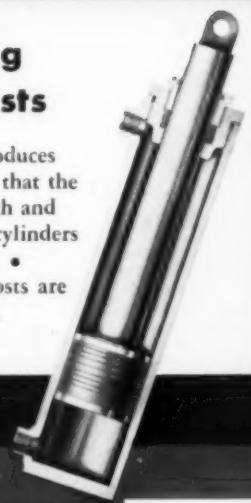
Rockdrawn® Quality Hydraulic-Line Tubing

Rockrite high surface finish tubes are precision cold drawn to produce Rockdrawn small-diameter tubing that is consistently of the highest quality.



Cylinder Tubing cuts honing costs

The Rockrite process produces such a high surface finish that the tubing can be cut to length and used as is for hydraulic cylinders with soft-packed pistons. • Machining and honing costs are always cut to a minimum.



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Let our packing design specialists help you determine the right packing for each specific job. Your special needs are followed to the letter . . . and MARSH packings are built the way you need them . . . to give dependable service for a long long time.

MARSH THERMO LEATHER PACKINGS

IMPREGNATED WITH SYNTHETICS

ARE DESIGNED "RIGHT" FOR THE NEED

Quality and Dependability
Backed by ***55 Years*** *of Leadership*

CUP PACKING
A piston packing for use on cylinders and controls, low or high pressures.

U PACKING
A single-lip rod or piston packing against low to moderate high pressures.

NON-EXTRUSION OR BACK-UP WASHERS
For use with "O" rings—eliminates extruding and keeps grit and dirt away from "O" rings.

V PACKING
A multi-lip rod packing against medium or high pressures.

FLANGE PACKING
A single-lip packing against low to moderate high pressures.

CUP AND HEEL WASHER
For use against higher pressures—eliminate pinching due to too much clearance.

Engineering and Consulting Service
Ask MARSH field engineers to survey your packing needs and make recommendations.

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BRIEFS / continued

Future Events

October 8-12: 38th Annual Metal Congress and Exposition, Public Hall and Auditorium, Cleveland, Ohio.

October 8-12: SAE Aircraft Committees A-3, A-6 and A-6C. Hotel Biltmore, Los Angeles, California.

October 18-19: 12th National Conference on Industrial Hydraulics. Sherman Hotel, Chicago, Illinois. To register for the NCIH, write Illinois Institute of Technology, Chicago, Ill. Conference Secretary Raymond D. Meade.

October 22-26: Detroit's National Industrial Exposition, Detroit Artillery Armory. In conjunction with the exposition an extensive series of management-engineering conference sessions will be held Oct. 23-26. The exposition will feature new products, new methods and research developments.

October 30-November 1: 1956 Fall Meeting, National Fluid Power Association, Hotel Cleveland, Cleveland, Ohio.

November 24-30: ASME Annual Meeting, Hotel Statler, New York, N.Y.

November 26-30: 22nd National Exposition of Power and Mechanical Engineering. New York City Coliseum, New York.

November 26-30: Third International Automation Exposition. New York Trade Show Building, New York City.

January 14-18, 1957: SAE Annual Meeting and Engineering Display. The Sheraton-Cadillac and Statler Hotels, Detroit, Michigan.

January 28-31: Plant Maintenance and Engineering Show. Public Auditorium, Cleveland, Ohio.

March 20-22: SAE Production Meeting and Forum, Hotel Statler, Buffalo, N. Y. ▼▼▼

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The Only Complete Line of

BALL • REVOLVING
SWIVEL • SWING

JOINTS

WHEREVER PIPING CONNECTIONS MUST MOVE, look to BARCO for the ANSWER! Whatever your problem, Barco, invariably, can solve it BETTER, EASIER, and QUICKER with a tested and proven joint right out of the standard Barco line. This is because Barco builds a truly complete line of flexible ball, swivel, swing, and revolving joints — *there is a size and type for every purpose!* Submit your problem; ask for recommendations — Barco is at your service.

Flexible

BALL JOINTS

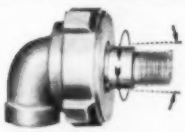
for Angular Flexing and Swivel or Twisting Movement

This is a versatile, general purpose design suitable for many applications. Standard the world over where low cost, leakproof, movable joints are needed in piping handling steam, air, water, oil, gas, or chemicals. One joint will frequently serve the same purpose as several one-plane swing joints. Up to 40° side flexibility *plus* 360° swivel action facilitates quick connection of piping, overcomes misalignment. Pressures to 4,500 psi; temperatures to 1,000°F. 12 styles, sizes from ¼" to 12".

Self-Aligning

SWIVEL JOINTS

for Swivel Motion



Specially designed for steam service and widely used in making compact, low torque connections to reciprocating or hinged parts on platen and tire presses, construction machinery, die casting machines, oil burners. Barco's *self-aligning* feature provides side-flexibility (up to 10°) which speeds up installation and prevents binding. Easy to position piping accurately—no sagging, flopping lines. Leakproof, pressure safe. Ratings as high as 750 psi steam and 600°F., 3,000 psi (hydraulic). Sizes, ⅜" to 2"; angle or straight.

High Speed

REVOLVING JOINTS

for Clutches, Chucks and Machine Tools

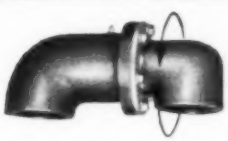
¼" Type NV. Used in making high speed, leakproof rotary connections for pneumatic, hydraulic, or coolant lines. Light running, sealed ball bearing design handles both radial and end thrust with low torque and minimum wear. Easy to install where space is limited; economical. Precision built for rugged service. For speeds to 2500 RPM; pressures to 300 psi (air) or 1500 psi (hydraulic).

Plane

SWIVEL JOINTS

for Hydraulic and Pneumatic Service

Here is a new light weight, low cost "single plane" swivel joint for small piping or tubing. Also used as swivel connectors for hose to eliminate torsional working stresses and long radius bends. Built with ball-bearing or thrust bearing. O-ring seal. Very low torque under pressure. Choice of styles; sizes ¼", ⅜", ½", ¾" for service to 2,000 psi,−20° to 225°F. Other types available for higher ratings.



"Controlled Torque"

SWING JOINTS

for Loading Racks, Fueling Assemblies

Built to support piping and provide for swing movement in handling gasoline, oil, alcohol, and other fluids. *Special ball bearing, long sleeve design* with exclusive "controlled torque" action permits uniform, easy movement, but prevents annoying uncontrolled swinging. Single swing, double swing, and counterbalance styles with counterweights to meet every need. In steel, malleable iron, or Bar-Ductile metal, sizes 1", 1½", 2", 2½", 3", 4", 6", 8", 10", 12". Also complete loading line assemblies.

for 3000 P.S.I. Operating Pressure

Aircraft Type **SWIVEL JOINTS**

Only BARCO offers BOTH!

PLANE SWIVEL JOINT—
360° rotation in a single fixed plane.

SELF-ALIGNING SWIVEL JOINT—
360° rotation *plus* 15° side flexibility.

SEND FOR INFORMATION

BARCO MANUFACTURING CO.
532L Hough Street, Barrington, Illinois

Gentlemen:
Please send me information about Barco Products checked at right:

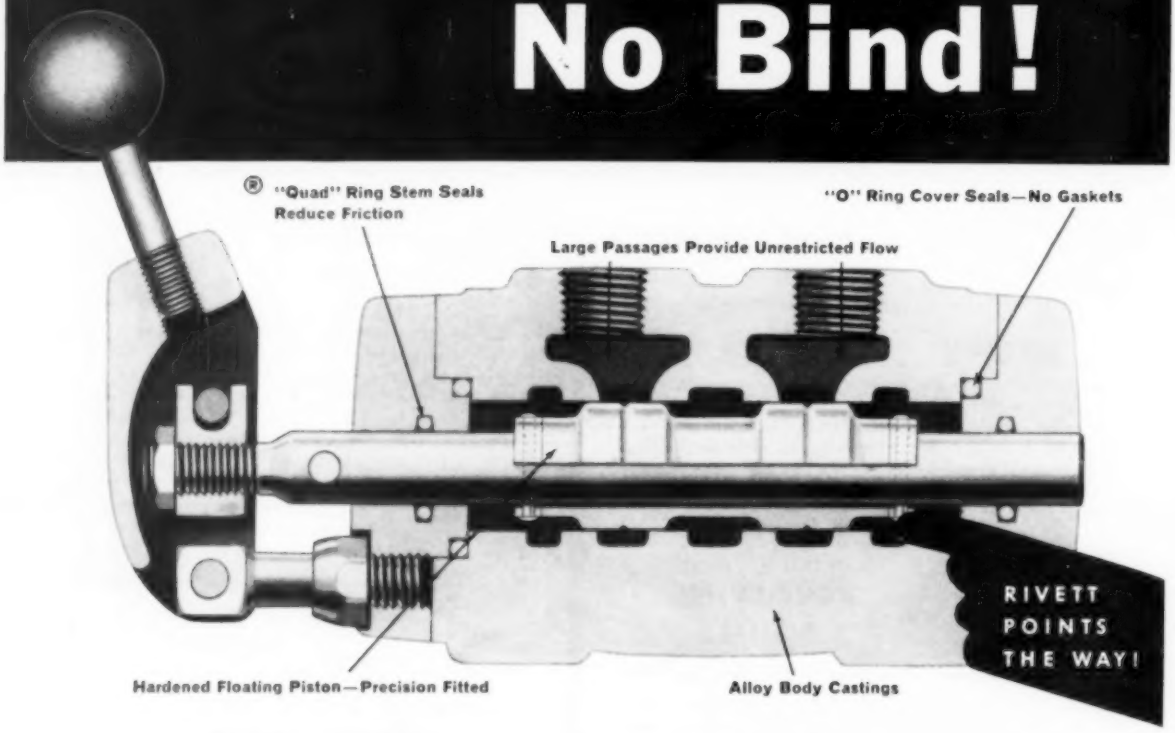
Name _____

Company _____

Address _____

- ☐ BALL JOINTS. Catalog 215B.
- ☐ SWIVEL JOINTS. Catalog 265B.
- ☐ PLANE SWIVEL JOINTS. Catalog 406A.
- ☐ REVOLVING JOINTS. Catalog 300A.
- ☐ TYPE NV REVOLVING JOINTS. Catalog 307.
- ☐ BALL BEARING TYPE SWING JOINTS. Catalog 400A.
- ☐ INSULATING (Electrolytic) JOINTS for Piping.
- ☐ SWIVEL JOINTS FOR AIRCRAFT. Catalog 269A.

No Stick! No Bind!


® "Quad" Ring Stem Seals Reduce Friction
"O" Ring Cover Seals—No Gaskets
Large Passages Provide Unrestricted Flow
RIVETT POINTS THE WAY!
Hardened Floating Piston—Precision Fitted
Alloy Body Castings

—with Floating Piston!

Valve Stem is Independent of Valve Bore in Rivett Hydraulic Pipe Mounted Valves

Other Fine Features Benefiting Your Circuit Design and Operation

- "Quad" Ring Stem Seals Reduce Friction
- Large Passages Provide Smooth, Full Capacity Flow
- Simple Design Assures Leakproof Operation
- Opens And Closes Smoothly, Positively
- Operates Multi-Million Cycles At 1500 P. S. I.

1607 VALVE SELECTIONS!

Types: Hand, foot, cam, solenoid, pilot, oil pressure, air pressure, flow control, check, deceleration, relief, unloading, sequence, counterbalance.

Sizes: ¼", ⅜", ½", ¾", 1", 1¼", 1½".

Actions: Standard, spring-return, spring-centered, ball detent.

Mountings: Pipe mounted; panel mounted.

P.S.I.: 1500 P.S.I.; 3000 P.S.I. oil service.

Piston designs for any circuit.

RIVETT, INCORPORATED • Dept. AH-10
Brighton 35, Boston, Mass.

THE BETTER YOU KNOW HYDRAULICS THE BETTER YOU LIKE

Get Catalog No. 204 to aid your circuit design. Complete drawings, specifications, cut-away views, tables, diagrams!

® "QUAD RING" is the registered trademark of the Minnesota Rubber and Gasket Company.

RIVETT
"100"
HYDRAULIC VALVES

We say this without reservation—will back it up with proof:

New Balanced Mobil D.T.E. Oils Can Improve Your Production And Reduce Manufacturing Costs

For years Mobil D.T.E. oils have set the standard of quality for all hydraulic and circulating oils. Recently they were dramatically improved—so much so that their margin of superiority is now greatly increased.

New Mobil D.T.E. oils are *balanced* to meet the widest range of operating conditions. They will give years of trouble-free service—even in continuous high temperature circulating systems. They will keep your machines free from deposits over the complete range of service. They will give you the highest degree of protection against wear... rust... corrosion. In fact, tests show *most machines will become obsolete before these oils need changing* when operating at normal temperatures.

Let us show you concrete *proof* that new balanced Mobil D.T.E. oils can improve production and cut manufacturing costs. Ask your Mobil representative for the "balanced" story.

SOCONY MOBIL

FIRST STEP IN CUTTING COSTS

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

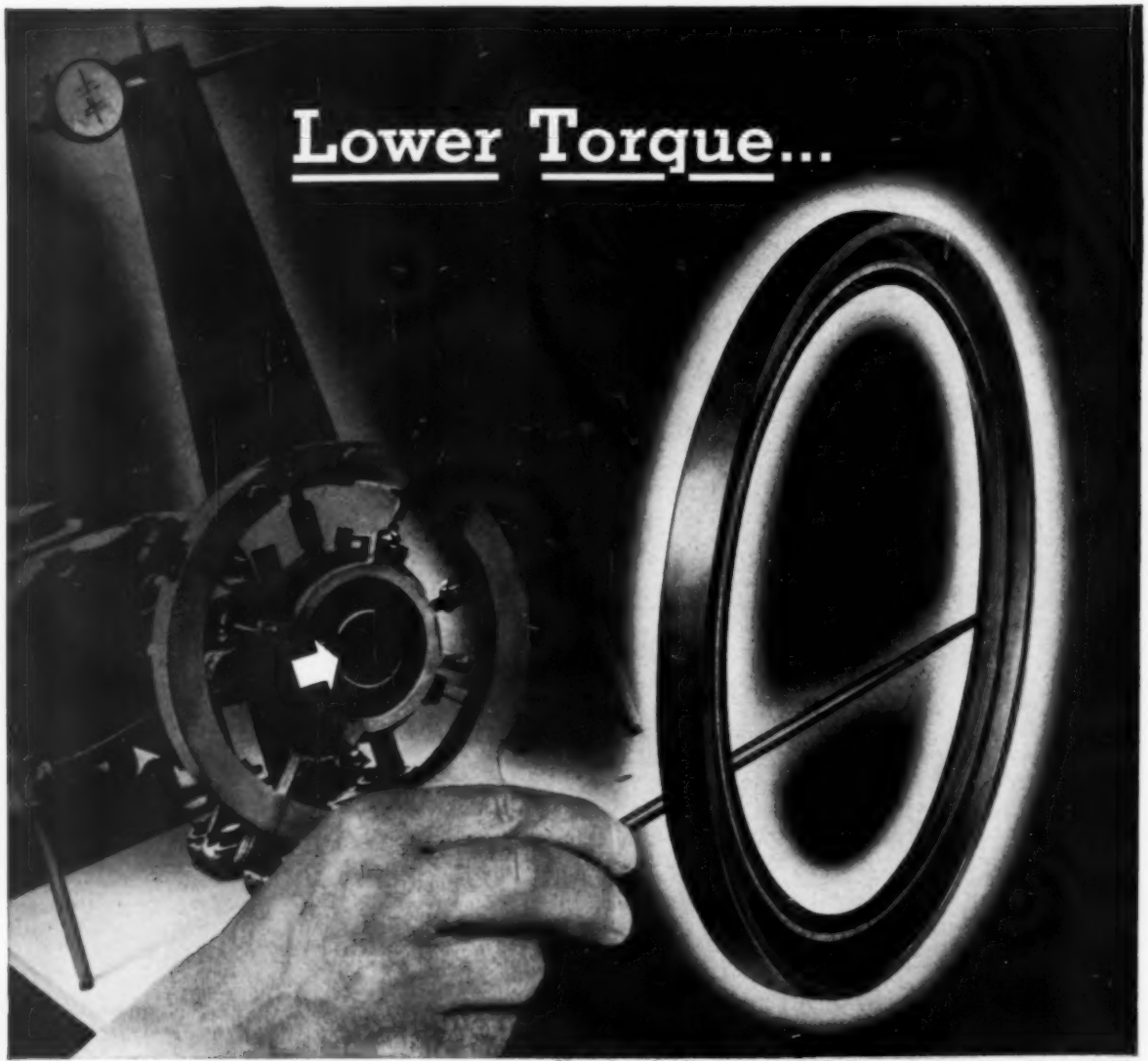


Photo shows hairline contact of LPD Clipper Seal which provides negligible torque when seal is tested on dry run of torque measuring apparatus.

How J-M Clipper Oil Seals cut shaft drag

line contact minimizes interference... provides cooler running

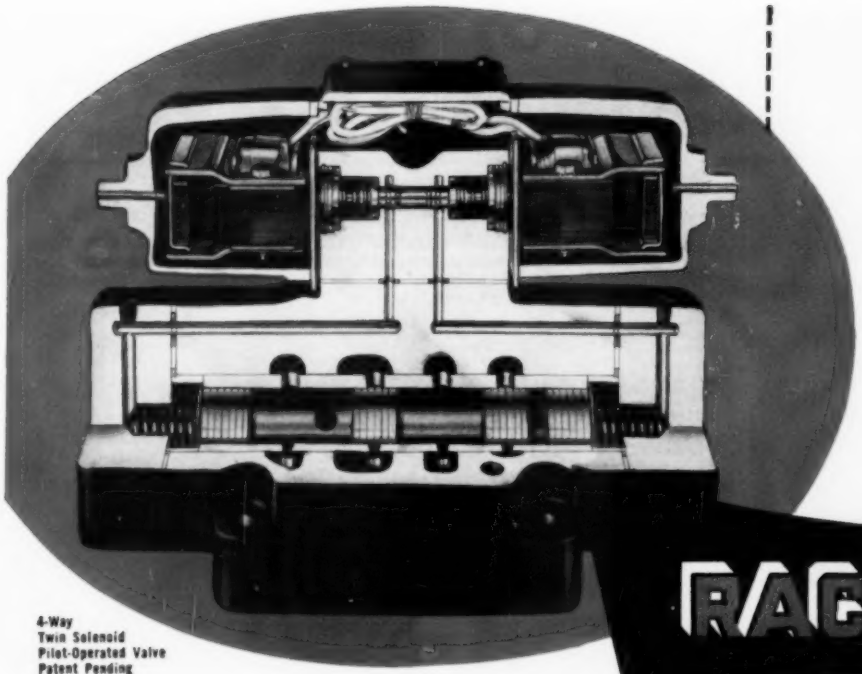
Take a close look at the lip of a Johns-Manville Clipper Seal. You'll see how the bearing area has been narrowed down to a sharp line contact. That's why you get less power consumption and lower operating temperatures when you use Clipper Seals to seal in lubricant, seal out dirt.

What's more, this line contact requires less lubrication and yet receives far more in proportion to its surface than any other design. It all adds up to greater sealing efficiency and longer seal life for Clipper Seal users. This exclusive line contact feature is provided on all LPD Clipper Seal designs which are adaptable to most applications.

Lower torque is only one of many advantages you get with J-M Clipper Seals. Precision moulded from a variety of corrosion-resistant compounds specially developed for each service, they provide maximum sealing ability, long life, wide adaptability and easy installation. For more information on the complete line of Clipper Seals, write for new 28-page illustrated brochure PK-71A. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada: 565 Lakeshore Road East, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CLIPPER SEALS



4-Way
Twin Solenoid
Pilot-Operated Valve
Patent Pending

RACINE®

SLEEVE TYPE VALVES GIVE BETTER CONTROL

Proper control of oil flow improves the operation of your machines.

RACINE Sleeve Type Valves are designed with round drilled parts that assure smooth, control of oil to cylinders and fluid motors.

These RACINE Valves are provided with dust-proof solenoid covers — a pending patent includes a RACINE feature that prevents solenoid operation and injury to operator when covers are removed or loose.

Built to J.I.C. specifications RACINE Valves are approved for use in all critical applications. They are precision-built, compact, and rugged in design. Operating pressures to 2000 psi with full back pressure on exhaust port.

Your machine will operate better, with less maintenance because of longer life of RACINE Sleeve construction. Write today for complete catalog showing why "Sleeve Type Valves give Better Control."

OTHER RACINE
HYDRAULIC PRODUCTS

MODEL Q
Variable Volume
Vane Type
Hydraulic Pump

PRESSURE BOOSTER
Up to 5000 psi
Up to 7:1 pressure ratio

FLUID MOTOR
Vane Type
50 to 3500 rpm
Pressures to 1500 psi

RESERVOIR
With Control Panel
Designed to your space
and circuit requirements

NFPA NATIONAL FLUID POWER ASSOCIATION

RACINE — STANDARD FOR QUALITY AND PRECISION — RACINE HYDRAULICS & MACHINERY, INC.

RACINE HYDRAULICS & MACHINERY, INC.
2074 Albert Street
RACINE, WISCONSIN, U.S.A.

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

DUAL GEAR PUMP
...for crawler steering

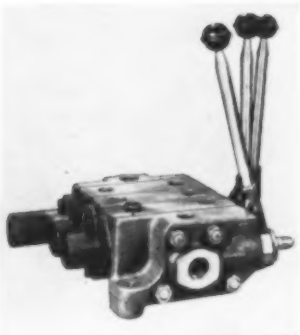
Designation: Series 1500

Application: 1500-psi pump is designed for power steering control on both right and left-hand tracks of large crawler equipment. Pump has through-shaft to provide drive for magnetos and other auxiliary components.

Construction: Pressure-balanced wear plates keep volumetric efficiency high at all pressures. Balanced hydraulic forces on both sides of the plates maintain fixed clearances between plates and gear faces, so oil slippage is reduced to a fixed minimum, and frictional contacts are eliminated. Various mounting arrangements are available.

Kalamazoo Div.
The New York Air Brake Co.
Kalamazoo, Mich.

Circle 160 on Reader Service Card



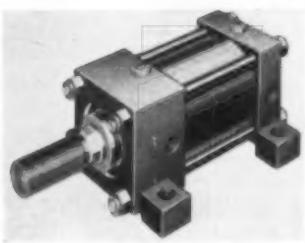
2000-PSI VALVE
...for mobile equipment

Construction: Multi-directional, sectional control valve is constructed with solid balanced spools, and each section has a built-in check, so that no pressurized return flow can occur, even if two sections are operated at the same time. This eliminates load drop. Combined with a design permitting smooth throttling, this feature permits operation of two or more valve sections simultaneously. Check valves are located so that they cause no constriction of oil flow passages.

Design: All internal passages have area equal to ports, minimizing pressure drop and heat generation. Side and top inlet and outlet ports are provided and direct return tank mounting is available. Valves are available with ports for tapered thread or SAE split-flange connections. Cartridge type relief valve with either screw or slug adjustment is provided in the inlet section. Since it has a "dribble" point close to the point of blow-off, and little spread between blow-off and reseat points, the relief valve can function as a pressure control valve. O-rings instead of gaskets are used for sealing.

Commercial Shearing
& Stamping Co.
Youngstown, Ohio

Circle 161 on Reader Service Card



HYDRAULIC CYLINDERS
...72-inch maximum stroke

Designation: Supermatic

Construction: Cylinders for 2000 psi are available in seven bore sizes from 1½ to 6 inches. Five mounting styles are available including foot, trunnion, centerline, flange, pivot and manifold with interchanging covers to permit multiple mounting combinations. Front and blind-end covers are of heavy steel plate and piston rods are highly polished steel to assure minimum friction and maximum packing life. Cylinder tubes are hard-drawn and corrosion resistant for low friction. Ports are unobstructed and can be relocated to any 90-degree position by rotating cylinder covers. Tie rods are extra heavy to maintain tension and resist shock loads. Cushioning is available for either or both ends.

Logansport Machine Co.
Logansport, Indiana

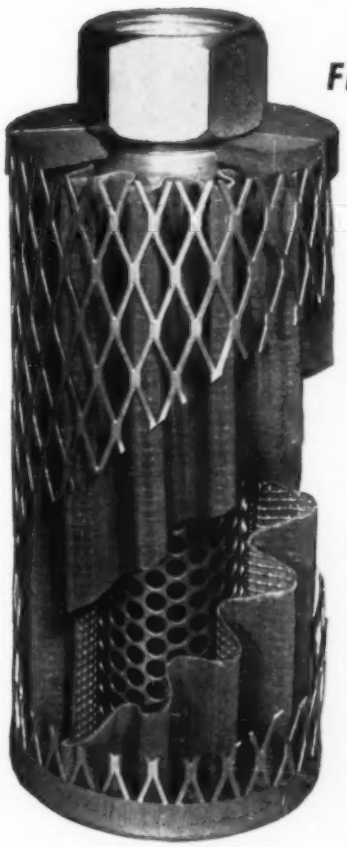
Circle 162 on Reader Service Card

Continued on page 58

MARVEL Synclinal FILTERS

For Efficient Filtration of–

Hydraulic Oils
Fire Resistant Hydraulic Fluids
Coolants – Lubricants
Water



SUMP TYPE (Cutaway)

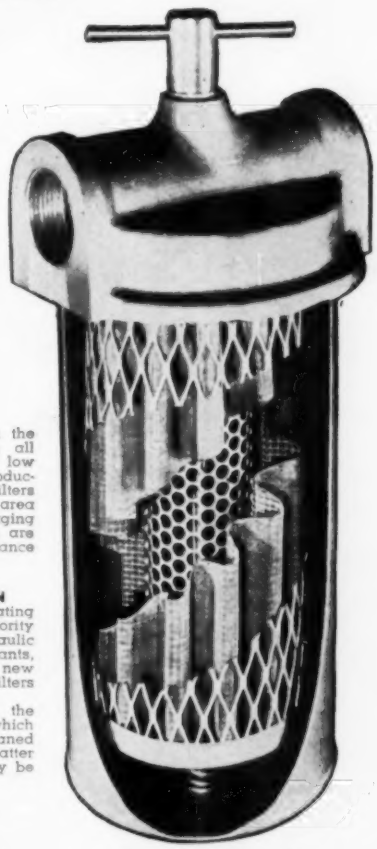
OVER 700
Original Equipment Manufacturers Install Marvel Synclinal Filters as Standard Equipment

PROTECT EQUIPMENT
INCREASE PRODUCTION
REDUCE MAINTENANCE

Marvel Synclinal Filters installed in the sump or on the line preceding pump offer maximum protection on all hydraulically actuated and other equipment utilizing low pressure circulating oil systems. Maintenance and production costs are reduced because Marvel Synclinal Filters BALANCED design offers greater ACTIVE filtering area with sufficient storage capacity for filtered out damaging particles, thus, longer periods of productive operation are attained at minimum "down-time" due to maintenance and repairs.

PRODUCTION ENGINEERS AND MAINTENANCE MEN whose job it is to keep production machinery operating at peak efficiency and who have recognized the superiority of Marvel Synclinal Filters in the filtration of hydraulic oils, fire resistant hydraulic fluids, coolants, lubricants, etc. are specifying Marvel Synclinal Filters on all new equipment and standardizing with Marvel Synclinal Filters on all machines within their plants.

Another outstanding reason for their preference is the simple construction of Marvel Synclinal Filters which allows them to be easily disassembled, thoroughly cleaned and reassembled on the spot, by any workman in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.



LINE TYPE (Cutaway)

Meet J.I.C. Standards

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by mutliple installation (as described in catalog). Choice of Monel mesh sizes range from coarse 30 to fine 200.

IMMEDIATE DELIVERY!

As in the past, Marvel continues to offer immediate Delivery!

Catalogs containing complete data available on request

MARVEL ENGINEERING COMPANY

7227 N. Hamlin Ave., Chicago 45, Ill. **PHONE: Juniper 8-6023**

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated: (AH-10)

- ☐ Catalog #107—For Hydraulic Oils, Coolants, Lubricants.
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

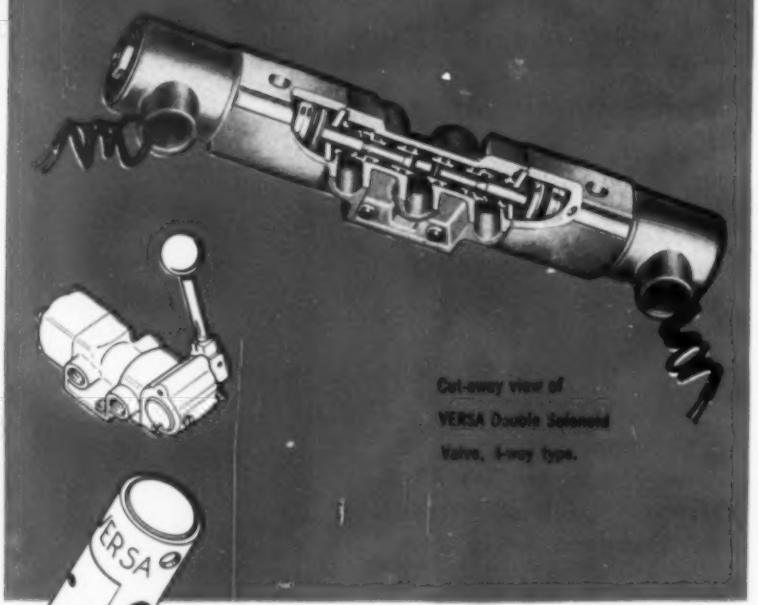
Name _____ Title _____

Company _____

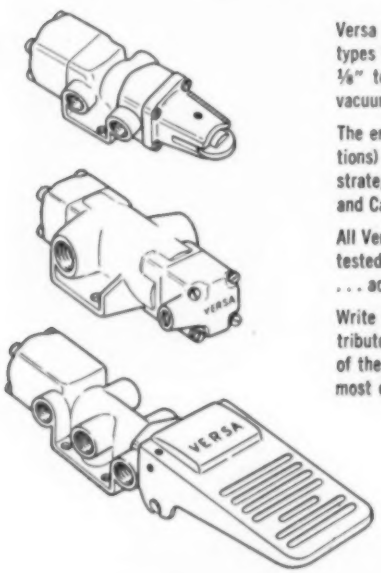
Address _____ State _____

VERSA Control Valves

FOR IMMEDIATE DELIVERY...



in Over 110,000 Variations!



Versa Valves are available in 2-, 3-, 4-, and 5-way types with over 20 actuating devices, in sizes from ⅛" to 1" N.P.T., and for pressures from partial vacuum to 500 PSIG.

The entire line of Versa Valves (over 110,000 variations) are stocked by authorized Versa distributors, strategically located throughout the United States and Canada.

All Versa Valves are triple pressure and functionally tested under water for guaranteed leakproofness . . . actually exceed J.I.C. standards.

Write today for the name of your nearest Versa distributor. Remember, you can get immediate delivery of these rugged, compact control valves to fit your most exacting hydraulic or pneumatic requirement.

The entire line of VERSA Valves is explained in our new comprehensive Folder #14

VERSA

VERSA PRODUCTS COMPANY INC.
248-A SCHOLES STREET
BROOKLYN 6, N. Y.

New Products / continued

SNAP ACTING SWITCH
. . . is completely sealed

Designation: 2HB Series

Construction: Switch has silicone boot to seal the clearance space around the operating pin. Cover is sealed to base with a thermo-setting resin which excludes moisture, oil, dust, condensation and

corrosive gases from the switch mechanism.

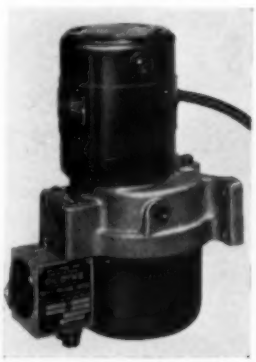
Specifications: Switch is available with variety of actuators permitting a wide range of actuating devices. Unit is listed by Underwriters Laboratories for operation at 20 amperes, 125, 250, and 480 volts a.c. or .25 amperes at 250 volts d.c. and 150 amperes at 125 volts d.c.

Unimax Switch Div.
W. L. Maxson Corp.
Wallingford, Conn.

Circle 163 on Reader Service Card

HYDRAULIC POWER PACK
. . . is exceptionally compact

Features: Power pack requires no cumbersome mounting base and may be mounted anywhere in a



horizontal or vertical position. In vertical mounting position, pump may be inclined as much as 45 degrees. Unit measures less than 9 x 6 x 4½ inches. Pack consists of an

Continued on page 60

LOOK TO RMC For Full-line Instrumentation

GAUGES AND SWITCHES FOR HYDRAULIC APPLICATION

PRESSURE GAUGES

RMC pressure gauges are capable of withstanding very high overload pressure above a nominal scale reading. Various types are available in different models, sizes, etc. All are built for use on heavy-duty equipment, to maintain accurate readings regardless of mechanical vibration, or exposure to dust and weather.

MODEL #2450

LIQUID LEVEL GAUGES

RMC liquid level gauges are made in many types and sizes for applications such as hydraulic fluid reservoirs, sumps, etc., which are usually under pressure. All of these gauge heads are pressure tight, and installations can be made for high operating pressures.

MODEL #3110

MODEL #2900

PRESSURE AND VACUUM SWITCHES

The RMC No. 2900 series is designed for service on vibrating equipment. Mechanism is sealed dust-proof and watertight. The diaphragm is Buna N impregnated and calibrated at the factory to close or open a contact at fixed pressure (or vacuum) values. Double or single terminal models. Send for sample for inspection and test.

WHAT ARE YOUR GAUGE NEEDS?

Write, wire or phone—tell us your requirements for indicating instruments or actuating switches, and let RMC engineering skill provide the answers!

DIAL THERMOMETERS

For indicating temperature of hydraulic fluid, RMC's general line of industrial thermometers cover just about every possible application. All are of stainless steel construction, with hermetically sealed dials. They are factory calibrated and pressure tested. External dial reset device permits on-the-job calibration for pin-point accuracy.

MODEL #1825

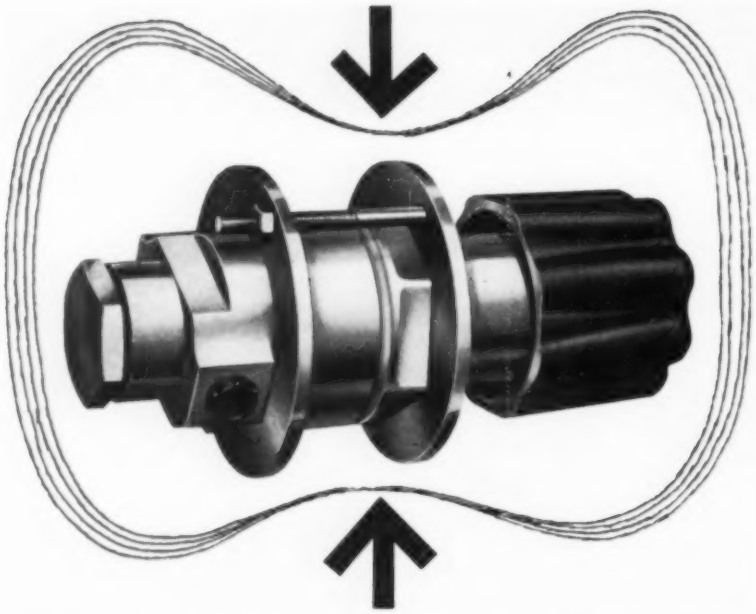
RMC

"You Can Rely On Rochester"

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

ROCHESTER MANUFACTURING CO., INC.

209 ROCKWOOD STREET • ROCHESTER 10, N.Y.



REVOLUTIONARY, NEW HIGH PRESSURE REGULATOR

Look at these outstanding new developments:

- Widest adjustment range available for manual regulation due to greater sensitivity created by a new engineering innovation!
- ¼" tube straight thread gasket seal bosses per AND10050!
- Maximum inlet pressure of 4500 psi!
- Internal relief valve and filter!
- Internal valve and filter are removable without disturbing spring, diaphragm structure!

Catalog Number	Adjustable Range Outlet Pressure PSI
110100-2	5/150
110100-4	15/300
110100-6	30/750
110100-8	150/1500
110100-10	400/3000

Write today for new engineering data sheet and catalog covering our complete range of regulators.

APCO **ACCESSORY PRODUCTS CORP.**
Dept. A-10, 616 W. Whittier Blvd.
Whittier, Calif., Phone: OXford 3-3747

New Products / continued

electric motor, high-pressure low-volume pump, couplings, integral reservoir, automatic valving for cylinder actuation, optional pressure switch, and mounting bracket. **Design:** Power pack eliminates need for separate solenoid valves, relief valves, and reservoirs. Pressure to 3000 psi is developed with 5000-psi peaks. Cylinder actuation is controlled through two oil lines between pump and cylinder. Two internal valve arrangements are available: one locks cylinder in infinite holding position, the other allows free movement of cylinder except during actuation. Unit may be equipped with 115 V universal motor, low-voltage motor, or for operation from 12-volt batteries.

Oil-Dyne, Inc.
Chicago, Illinois

Circle 164 on Reader Service Card

OIL COOLER
. . . is more compact

Designation: WIO

Design: Oil Cooler has inner-fin construction which permits more cooling in less space and permits

compact design with lower operating cost. Unit is of completely non-ferrous construction with brass shell and copper tubes. Cooler is available for operating pressures to 250 psi and temperatures to 300 degrees F.

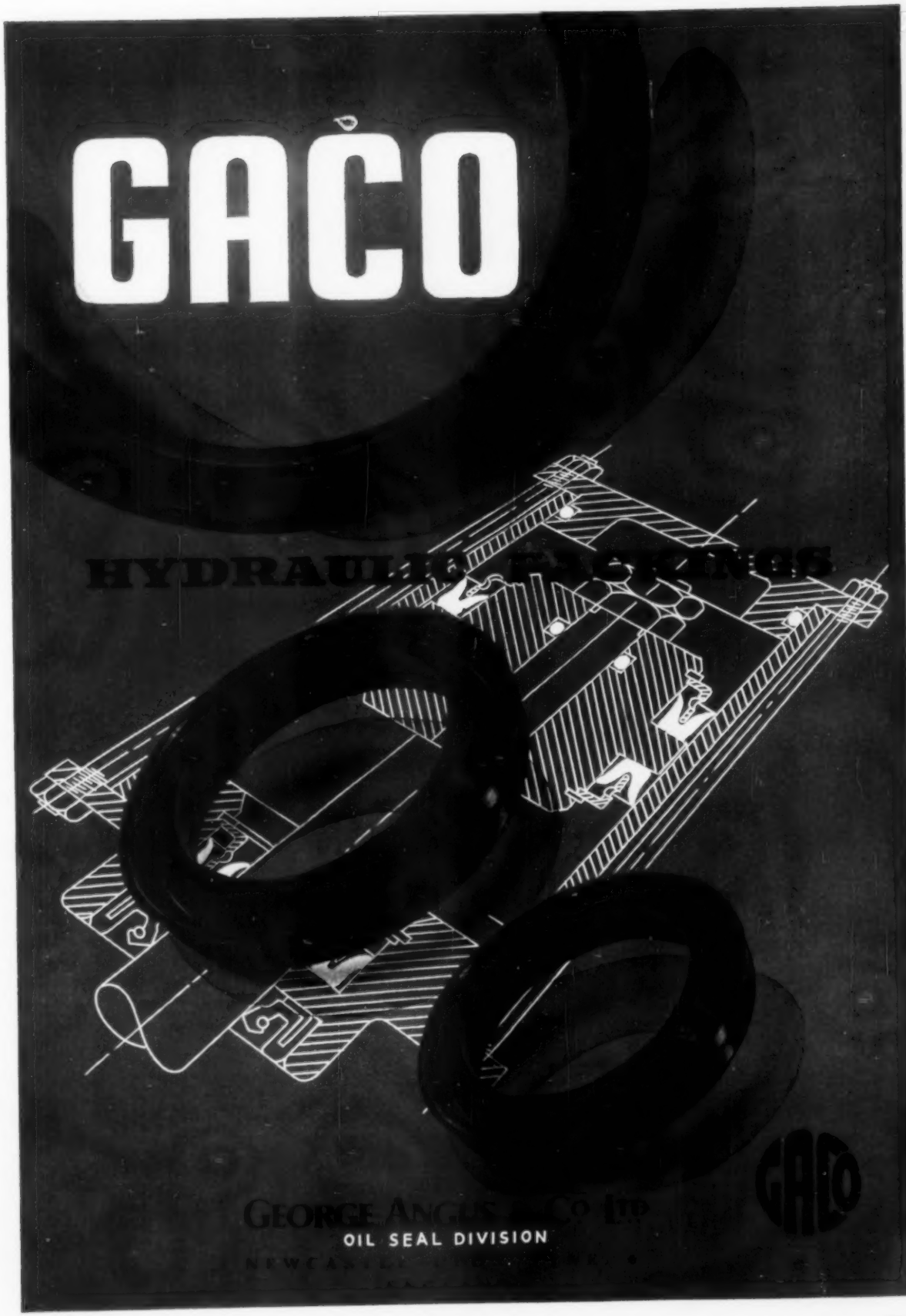
Heat-X, Inc.
Brewster, N. Y.

Circle 165 on Reader Service Card

CAP SCREWS
. . . sizes 0 through 3

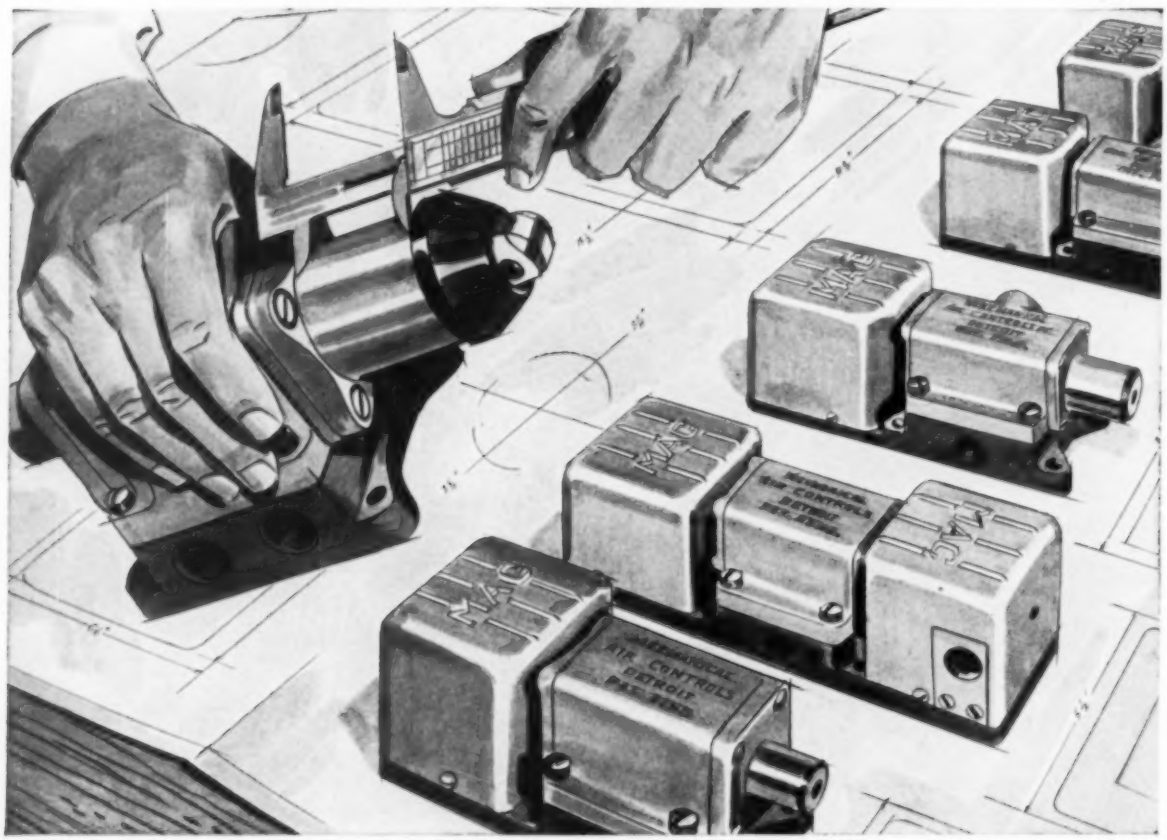
Features: New micro sizes are now available in heat-treated alloy steel line of socket cap and set screws completing the range of socket cap sizes to 3½ inches in diameter and of socket sets to 1¼ inch. Also available is a line of socket head shoulder screws of heat treated alloy steel in standard diameter sizes from ¼ to ¾ inch and heat treated, alloy steel, tight seal pressure plugs in standard pipe sizes from 1/16 to 1¼ inch. Another new product is precision ground dowel pins in

Continued on page 63



Circle 14 on Reader Service Card

QUALITY IS STANDARD... RIGHT DOWN THE LINE



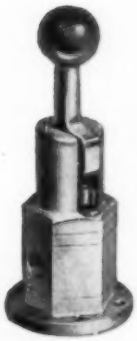
If you walked into our plant you'd hear the rhythm of air valves . . . see machines and men—*just testing!* They're the "fault-finders"—methodically inspecting each MAC valve . . . checking alignment and bore precision . . . hunting a defect in a spring, a faulty solenoid or an imperfect seal. The slightest flaw brings a quick reject. For at MAC we're building *reputation* as well as valves. We make high quality standard on all 98 models.

You'll find MAC valves outstanding, too, for dependability, performance *and value.* They're lighter, more compact, have fewer parts to wear. MAC's simplified design assures millions of operating cycles — with little, if any, maintenance. Small wonder MAC valves are showing up on more and more equipment at tool shows, in shops and plants, *everywhere.*

Why not contact us? We're happy to lend our know-how to any air valve application or problem. There's no obligation, of course. Write for free literature or call one of the MAC representatives listed at right.

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park, Detroit 37, Michigan

MAC



PHONE YOUR NEARBY "MAC" REPRESENTATIVE FOR DATA AND DELIVERY

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OAKLAND 8—The Rucker Co., 4700 San Pablo Ave., OLympic 3-5221
SOUTH GATE—The Rucker Co., 4956 Firestone Blvd., Kimball 8271

COLORADO (and NEW MEXICO, UTAH, WYOMING)
DENVER 16—Blair Engineering Co., 4100 Grape St., FLorida 5-7142

ILLINOIS
CHICAGO 43—Mike C. Modrich Co., 10918 South Western Ave., Hilltop 5-3640

INDIANA
FORT WAYNE 3—Neff Engineering Co., P.O. Box 2001, Station A, 2339 Crescent Ave., EAstbrook 7391
INDIANAPOLIS 20—Neff Engineering Co., P.O. Box 7361, 42nd St. Station, BRoadway 2330
SOUTH BEND—Dick Futter, 103 South Varsity Dr., CEntral 2-4856

MASSACHUSETTS (and New England)
BOSTON 34—Electrical Apparatus Co., Inc., 1200 Soldiers Field Rd., STadium 2-7440

MICHIGAN
BAY CITY—Fred Kober, 506 Chilson St., 2-2629
FLINT—Kober Sales Engineering Co., 514 Beach St., CEdar 8-5123

MINNESOTA
MINNEAPOLIS 4—Air Engineering & Supply Co., 2445 Nicollet Ave., FEderal 9-3579
ST. PAUL 14—W. H. Schulz Co., 2438 Franklin Ave., MIdway 4-2791

MISSOURI
ST. LOUIS COUNTY—Oscar E. Jost Co., P. O. Box 6, St. Ann, HArrison 8-4488

NEW JERSEY (Northern)
CRANFORD—The Roden Company, P. O. Box 305, CRanford 6-7330

NEW YORK
BUFFALO 21—C. H. Tepas Co., 200 Washington Hwy., Circle 3210
NEW YORK CITY AREA—J. Neill Armstrong Inc., 545 5th Ave., New York City, New York. MUrrayhill 7-6865.

OHIO
CINCINNATI—The R. W. Nichols Co., Fidelity Federal Savings Bldg., 2087-9 Sherman Ave., Norwood, ELmhurst 1-2440
DAYTON—The R. W. Nichols Co., 407 Realty Bldg., Michigan 4724
OLMSTED FALLS—The R. W. Nichols Co., P. O. Box 6, BErea 4-1379
TOLEDO—R. W. Nichols Co., 510 Manhattan Building, Toledo 4, CHerry 1-1447

OREGON
PORTLAND—The Rucker Co., 911 N. W. Hoyt St., BEacon 0205

PENNSYLVANIA
PHILADELPHIA—Grand Air-Hydro Co., P. O. Box 141, Glenside, TUrner 7-4296
PITTSBURGH 22—The R. W. Nichols Co., 101 Investment Bldg., ATlantic 1-6050

TEXAS
DALLAS 19—Womack Machine Supply Co., Shea Rd. at 7150 Harry Hines, FLeetwood 7-3871

WASHINGTON
SEATTLE—The Rucker Co., 1000 4th Ave., South, MAin 2783

WISCONSIN
MILWAUKEE 17—Neff Engineering Co., 5856 N. Pt. Washington Rd., EDgewood 2-1579

CANADA
ONTARIO, HAMILTON—Higginson Engineering Sales, P.O. Box 23 (275 James, North), JAckson 9-2262

MECHANICAL AIR CONTROLS, INC.
DETROIT 37, MICHIGAN

MAC

New Products continued

standard and oversize diameters from ⅛ through 1 inch. Also now available is a line of stainless steel

socket cap screws and socket set screws of 18-8 stainless steel, non-heat treated and non-magnetic. The cap screws with knurled heads for sure grip come in diameter sizes from No. 0 to ⅜ inch. Stainless set screws are available in sizes from No. 0 through ½ inch.

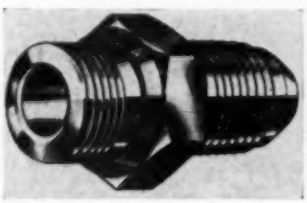
Cleveland Cap Screw Co.
Cleveland, Ohio

Circle 166 on Reader Service Card

STRAIGHT ADAPTER FITTING
. . . has all-metal seal ring

Designation: CN

Design: Straight adapter shape fitting is designed for positive, leak-proof sealing of all types of hydraulic fluids without use of O-rings. Fitting uses an all-metal seal



ring which produces a more positive feel of metal-to-metal contact.

Performance: In field tests fitting showed unusual resistance to heat and vibration because of the wedging action of the metal seal ring which acts as both gasket and lock washer. Fitting withstands excessive abuse in assembling and reassembling without damage to port or fitting. Port design is easy to machine and tolerances are liberal (100 micro-inch). Port contour is simple 30-degree angle.

L & L Manufacturing Co.
Van Dyke, Michigan

Circle 167 on Reader Service Card

LUBRICATON UNIT
. . . for machine tools

Designation 33AG-4

Advantages: Unit especially designed for machine tools supplies filtered, regulated, and lubricated air. The cabinet type unit which measures 6 x 6 x 5¼ inches has the following advantages: (1) fog lubrication with oil particles of micron size, (2) visible oil feed for accurate flow control and positive

proof of lubrication, (3) lubricator performance over an air flow range of 4 to 85 cfm (4) ⅜ pint oil reservoir, (5) clear and wide angle visibility of oil level, (6) easy oil refilling (7) relieving type pressure regulator, (8) choice of 64 or 25 micron filter element, (9) optional location of filter drain, and (10) two auxiliary air take-offs for supplying filtered air for other than lubrication purposes.

Design: Controls and indicators are located on front panel. No tools are required for access to the filter element and for oil refilling. Removable back cover provides easy access to other parts. Designed for main line pressures to 150 psi and regulated pressures to 125 psi, unit is available in ½-inch pipe size.

C. A. Norgren Co.
Englewood, Colorado

Circle 168 on Reader Service Card

For more NEW PRODUCTS reviews turn to page 154

SAVE MONEY WHILE SPENDING IT!

Specify

HYDRO-LINE

AIR & HYDRAULIC CYLINDERS

SAVE SPACE...

SPEED PRODUCTION...

SAVE DOWNTIME...

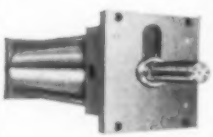
Compact design of HYDRO-LINE Cylinders with *exclusive* quick-change rod cartridge permits immediate replacement of rod seal, double lip rod wiper and rod bushing without removing or dismantling the main cylinder assembly. Other of HYDRO-LINE'S exclusive combination of features includes: all-steel end caps, one-piece piston retained by prevailing torque-type lock-nut, hard chrome plated piston rods, wrench-flats, heavy cushion adjusting needle valve interchangeable with ball check valve. Meet all JIC Standards.

WHEN YOU DESIGN . . . REMEMBER HYDRO-LINE!

SERIES R—Air or Low Pressure Hydraulic Heavy Duty Cylinder

TYPICAL APPLICATIONS

Clamping Fixtures
Loading & Unloading Devices
Counter Balance
Welding Machines
Air Clutches



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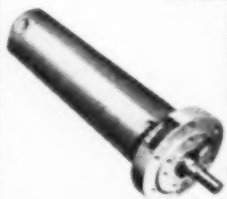
Bulletin Available at Later Date

SERIES J—High Pressure Hydraulic Extra Heavy Duty Cylinder

TYPICAL APPLICATIONS

Feed Cylinders
Slide Cylinders
Die Casting Shot Cylinders
Drilling & Tapping Machines



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Request Bulletin 53

SERIES S—Air or Low Pressure Hydraulic Extra Heavy Duty Automation Cylinder

TYPICAL APPLICATIONS

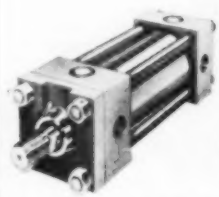
Clamping Fixtures
Welding Machines
Automation Equipment
Loading & Unloading Devices

Request Bulletin 55

SERIES N—High Pressure Hydraulic Heavy Duty Cylinder

TYPICAL APPLICATIONS

Feed Cylinders
Welding Machines
Die Casting Machines
General Machine Tools



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Request Bulletin 56

• Hydraulic and Air Cylinders • Dispensing Cylinders • Single Acting Cylinders • Adjustable Stroke Cylinders • Intensifiers

Representatives in all Principal Cities. Write for the name of the Hydro-Line Rep in your locality.

YOUR SAVINGS BEGIN HERE!

Please send bulletin ☐ 53 ☐ 55 ☐ 56

NAME _____

FIRM _____

ADDRESS _____

CITY _____ STATE _____

Hydro-Line CYLINDERS

Remember HYDRO-LINE when you design

HYDRO-LINE MANUFACTURING CO.

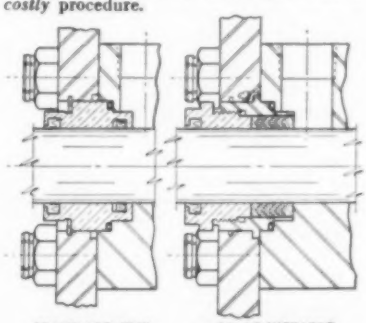
5605 PIKE ROAD • ROCKFORD, ILLINOIS

The ENGINEER'S Corner

As an engineer I am well aware of the importance of flexibility and problems brought about by continuing change which reach my department regularly. Our best answer to change is achieved through interchangeability. We are meeting this challenge by injecting flexibility in our line wherever possible.

Recently we were confronted with this problem of interchangeability on a large scale in a line of transfer machines for processing V-8 engine blocks for a large automotive manufacturer. The machines were designed by several large machine tool manufacturers to conserve all possible production space which meant that the hydraulic cylinders in a majority of the cases would not be mounted in easily accessible locations.

As a result when a severe leak showed up in a cylinder and it failed to maintain pressure the customer knew he would be faced with considerable downtime for cylinder removal and repairs. In some inaccessible locations as much as 8 to 10 hours would be involved. This would mean production stoppage of an entire shift and based on a production rate of 60 blocks per hour a *costly* procedure.



STANDARD "N" CYLINDER — with ADJUSTABLE PACKING

How Hydro-Line provides for interchangeability of Adjustable and Non-adjustable packing in Standard N Cylinders.

The natural solution would be a cylinder on which slow down or repair of a leak could be made until scheduled maintenance could make permanent repairs.

Along with other cylinder manufacturers we were asked to submit our solution. Our proposal was selected because it answered effectively the problem of adjustable packing and equally important because of the interchangeability provided through use of our standard N cylinder.

Our solution was to take our standard N cylinder with non-adjustable packing and equip it with a threaded gland packing retainer. By merely replacing bushings the customer could convert the cylinder from non-adjustable to adjustable packing or vice versa. It enabled the customer to take up the rod packing while the cylinder was still on the machine, stopping small leaks around the piston rod and executing temporary maintenance with complete safety until permanent maintenance could be achieved between shifts. Our standard N cylinder with non-adjustable packing and the converted N with adjustable packing were interchangeable even to end caps and follower. The problem was solved and interchangeability achieved to the complete satisfaction of the customer.

Joseph L. Bosi

Hydro-Line Manufacturing Co.
Chief Engineer

Circle 72 on Reader Service Card

Millions of strokes

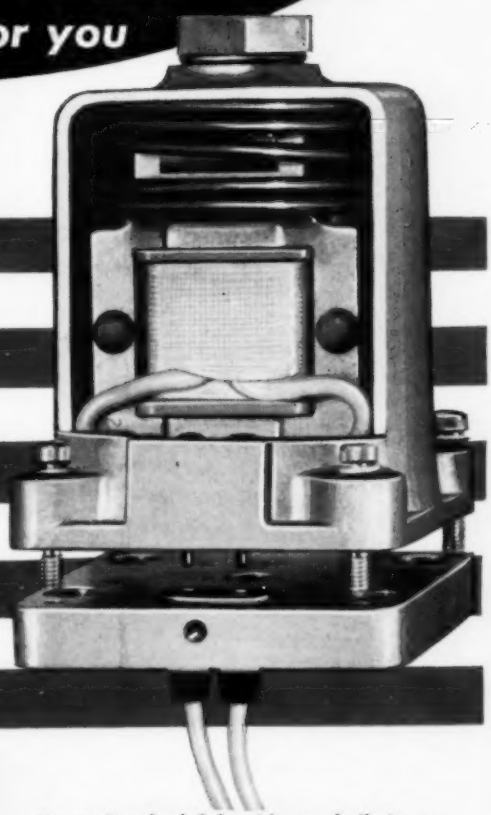
(at 300 strokes per minute)

—NO MEASURABLE WEAR!

that's how Decco's New Oil-Immersed Solenoid can perform for you

Decco's OIL-IMMERSED solenoid is so superior in performance and dependability, it is in a class by itself. Here are some of its outstanding features:

1. [illegible]
2. **Unbelievably little wear.**
3. [illegible]
4. **Operates 35° to 50° cooler than standard types.**
5. [illegible]
6. **Solenoid is completely sealed in compact, die-cast housing.**
7. [illegible]
8. **Shock-mounted in two directions.**
9. [illegible]



Decco SOLENOIDS

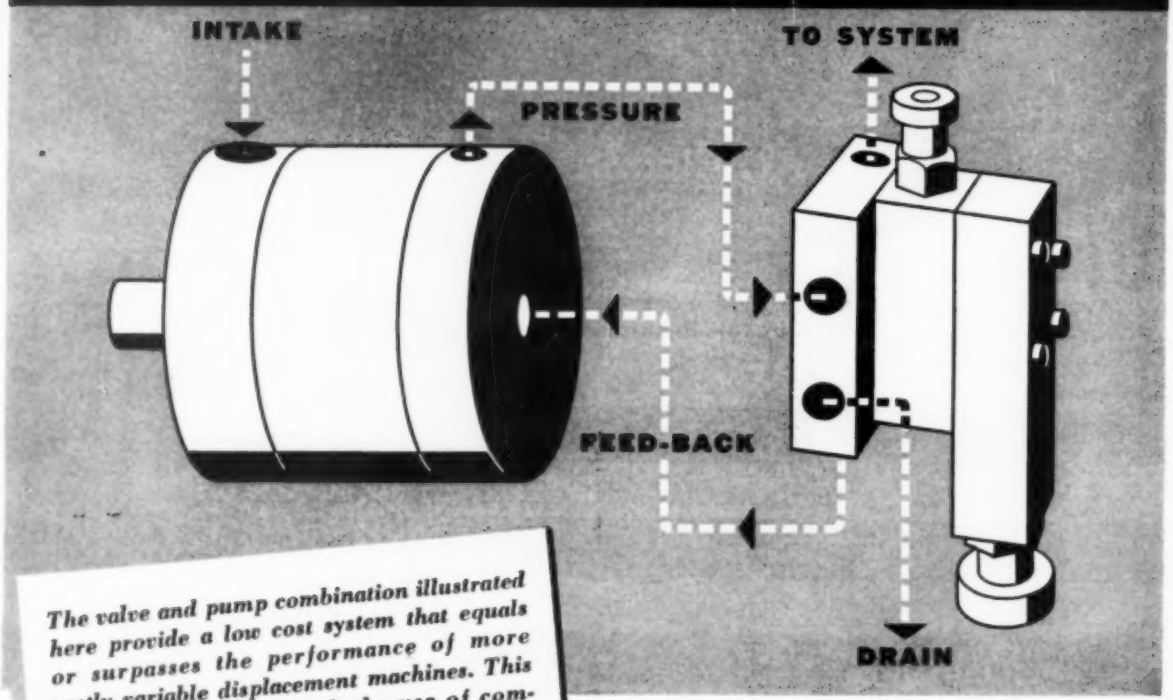
Decco Standard Solenoids are built in a complete range of sizes and types. Write for complete information.

DETROIT COIL COMPANY

2435 HILTON ROAD, FERNDALE 20, MICHIGAN

a Low Cost VARIABLE DISPLACEMENT SYSTEM

Comprised of the SECO D5 Radial Piston Pump, and D5PF Valve



The valve and pump combination illustrated here provide a low cost system that equals or surpasses the performance of more costly variable displacement machines. This is accomplished through the use of completely new feed-back techniques for displacement control. (Patents Pending)

With the maximum pressure set, the flow control section of the D5PF valve adjusts the displacement of the D5 pump to maintain a selected flow, independent of load pressure and input speed—within the capacity of the pump. The flow is continuously adjustable from zero to a maximum of 5 GPM. Pressure is adjustable from 200 to ***2,000 PSI***. Horsepower savings of as much as 85% are realized with the pressure compensation features of this system. Heating problems are negligible. The control valve can be located at the pump, or remotely, as required.

Send the Readers' Service Card for complete information.

SECO FLUID POWER

SIMPLEX ENGINEERING CO.
ZANESVILLE, OHIO

STANOIL *Industrial Oil tough performer in delicate operation*

A. T. Wallace (right), President of Wallace Tool and Die Company, and Standard Oil lubrication specialist, H. A. Peterson, check sensitivity of new Cincinnati Hydro-Tel Milling Machine which uses STANOIL as hydraulic medium. Howard Peterson has been providing technical service to customers since joining Standard Oil. He is a graduate of General Motors Institute. Howard's customers find this experience pays off *for them.*

Delicate operations with metal requiring almost a surgeon's skill are every day stuff to Wallace Tool and Die Company, Indianapolis. Recently, they purchased a Cincinnati Hydro-Tel Milling Machine for their highest precision work. They selected STANOIL Industrial Oil for the hydraulic medium. The reason for choosing STANOIL: they wanted a hydraulic fluid that could deliver high performance. They wanted a clean hydraulic system, free of deposits that might clog filters and interrupt operations. They wanted smooth operation without pump chatter and without foam. They got these with STANOIL.

How did Wallace Tool and Die come to choose STANOIL? The answer is not hard to find. They had used STANOIL for hydraulic systems throughout their plant for many years. It has given them the results they wanted so it was natural to pick STANOIL for their new Cincinnati machine.

With STANOIL the machine performs the delicate operation of contour tracing with only 3½ ounces of pressure needed to control the milling cutters. STANOIL gives them smooth, steady, uninterrupted performance.

STANOIL can serve you. In the Midwest a lubrication specialist at your nearby Standard Oil office will be glad to show you. Call him. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD

STANDARD OIL COMPANY (Indiana)

Circle 130 on Reader Service Card

GOLD N RING

Units are available in flush-plate or enclosed mountings, and are adaptable for special panel assemblies.

New...

Oil-tight • Water-tight • Dust-tight

Protected against oil and water seepage by Sealtight oil-resistant rubber diaphragm. Rated for 600 volts, AC or DC. Meets requirements of Joint Industry Committee and National Machine Tool Builders' Association.

EASILY REPLACES EXISTING SWITCHES—**Designed for mounting in $1\frac{13}{64}$" diameter holes on standard panel mounting centers, this switch easily replaces existing switches. Accommodates panel thicknesses of $\frac{1}{16}$" to $\frac{1}{4}$" in $\frac{1}{32}$" increments. Full interchangeability of units and their components permits ready adaptation to multiple assemblies.**

Another product of...

National Acme

Circle 95 on Reader Service Card

Sealtight CONTROL SWITCH

Made by machine tool builders to machine tool specifications

How often have you, when designing a machine tool, wished for a control station unit designed and constructed *"as a machine tool builder would build it."*

If you have been so handicapped in the past, you'll want to take a good close look at the NEW Namco GOLD-N-RING Control Station Switch Unit. Built by National Acme, builder of the world's only complete line of bar and chucking automatics, it is the *only* switch made *by* a machine tool builder *with machine tool know-how behind it.*

- **It is a heavy-duty switch in every respect.**
- **It is oil-tight, water-tight, dust-tight.**
- **Heavy-duty silver-alloy contact points provide maximum electrical capacity and long life.**
- **Heavy-duty terminal screws, with 3/8" thread contact, prevent stripping during installation and permanently secure wires for continuous trouble-free service.**
- **None easier to install; none more fool-proof.**

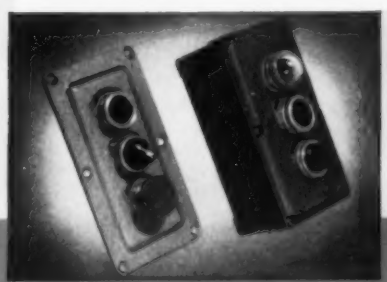
For complete details, send for Bulletin ECS-56. Better yet, ask for a representative to bring a switch for your examination.

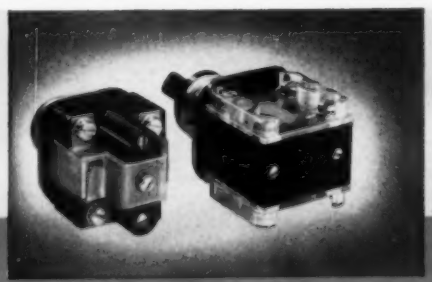
Electrical Mfg. Division • THE NATIONAL ACME COMPANY • Cleveland 8, Ohio

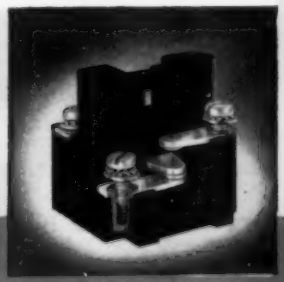
▼ **FLUSH PLATES OR ENCLOSURES** accommodate any combination of individual push button, selector or pilot light assemblies. Box covers and flush plates are provided with captive screws to facilitate installation. Easy-to-read, interchangeable legend plates lock securely into position.

▼ **SINGLE AND DOUBLE POLE CONTACT BLOCKS** can be used interchangeably with the several types of GOLD-N-RING push button and selector operator heads. Design provides easy access for secure wiring (or use of stake-on lugs) without interference. Fixed and movable contacts are completely enclosed by heavy plastic shields.

▼ **BRASS INSERTS** molded in block permanently hold stationary contacts. They also provide more thread support for the No. 8-32 terminal screws that are equipped with captive flat and lock type washers.

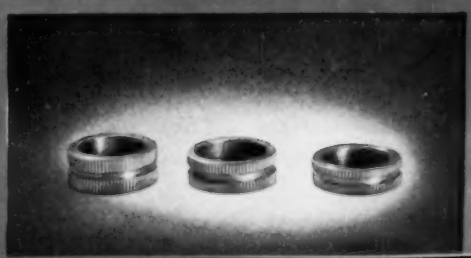






▼ **BUILT AS A MACHINE TOOL BUILDER WOULD BUILD IT!** Plastic shields (A) completely enclose contacts. Main block (B) is unit-molded to assure alignment and simplify assembly. Fully guided plunger (C) of cross-head design, prevents binding. Oil-resistant rubber diaphragm in operator head (D) completely seals out oil, water and dust. Easy-to-read legend plates (E) lock into position by "GOLD-N-RING" (F).

▼ **INTERCHANGEABLE "GOLD-N-RING" COLLARS** come in 3 different heights. Buttons can be made either extended or flush type merely by changing collar. Buttons are of non-fading glass-filled polyester and come in an assortment of colors to conform with standard codes.



Useful Literature

For your free copy of publications reviewed, fill in the reader service card

AIR, OIL VALVES . . . are specified in 65-page Catalog No. 456 published by Versa Products Co. The valves are made in 2, 3, and 4-way designs in sizes from ⅛ to 1-inch NPT. The valves which are rated for pressures to 200 and 500 psi are shown in hand, pilot operated, cam, and foot types. Manifold mounted valves are also shown. Detail sectional drawings are included to explain the construction and operation of the valves. A section is devoted to accessories including cam, hand, and foot actuators, and subplates.

Circle 220 on Reader Service Card

AIR CYLINDERS . . . produced by Munton Manufacturing Co. are specified in a brochure from the company. Various types of mounting are shown including flange, foot, pivot eye, and pivot clevis mountings. The cylinders have cartridge type bronze rod bearings which are easily changed. The rod wiper is encased in metal and is easily replaced. The cylinders have chrome plated piston rods and bronze cushions. Special mountings are available.

Circle 221 on Reader Service Card

SILICONE RUBBER . . . Two types of silicone rubber recommended for diaphragms, gaskets, seals, and O-rings are described in a brochure available from Dow Corning Corp. Much of the information is presented for the first time, and the brochure includes five graphs and twelve tables. A section devoted to physical properties discusses hardness as a function of temperature and heat aging, tensile strength as a function of temperature, and aging and tear strength. A section on use of silicone rubber for gaskets and seals treats the subjects of compression set, compression deflection, and chemical and oil resistance. A section is also devoted to the dielectric properties.

Circle 222 on Reader Service Card

RELIEF VALVES . . . are specified in a Mechanical Data Book issued by The Fulflo Specialties Co. Designed for pressures from 0 to 500 psi, the valves are available in pipe sizes from ¼ to 2 inches. A cylindrical piston closes off the port in a shearing manner and does not seat abruptly against the body of the valve. This relieves any pounding or chattering noise. The booklet contains flow-pressure curves as well as complete dimensional and constructional information. Drawings of several special valves show a 3-gang valve for use where a multiple use of valves is required in a limited space, and a 2½-inch flange valve with cast iron valve bonnet and body, steel cylinder, and hardened steel piston.

Circle 223 on Reader Service Card

ACTUATORS FOR AIRCRAFT . . . is the title of an informative booklet illustrating and explaining various types of self-locking hydraulic and pneumatic actuators. In the basic unit, locking is accomplished by the incorporation of a recirculation ball nut mounted integrally with the piston and piston rod. The ball nut engages a screw which is mounted in thrust bearings in the housing. Linear motion of the piston produces rotation of the screw. The various types based on this design include actuators with double roller no-back brake, servo brake, centrifugal brake, proportional drag, planetary gear override, and inertia control. Also shown are hydraulic actuators featuring positive mechanical synchronization, and a system of positive mechanical synchronized actuators with dual hydraulic supply and with mechanical slaves.

Circle 224 on Reader Service Card

VALVE TRACING TEMPLATES . . . to aid draftsmen in drawing 24 different valves produced by Ross Operating Valve Co. are offered by the company. The templates, containing top, side, and front views of the valves are in ¼, ½, and full size. By slipping the tracing template under a drawing, the draftsman's job of making copies through template paper or vellum is an easy one.

Circle 225 on Reader Service Card

SEQUENCE TIMER . . . for opening or closing as many as 12 circuits is described in Bulletin 323 from Eagle Signal Corp. The unit consists of a synchronous motor driving a cam shaft through a gear train. The cam shaft rotates continuously as long as the motor is energized. Adjustable cams determine the point of closing and opening a switch during each cam shaft revolution. The bulletin contains a selection table for units with ranges from 6-18 sec to 12-36 hr. Drawings and detail photographs show features of the timer such as the percentage dial which indicates the cam shaft position. The method of changing gears is outlined and illustrated, as well as the method of making cam settings. Dimensional and circuit diagrams are included.

Circle 226 on Reader Service Card

For more reviews of FREE LITERATURE turn to page 168

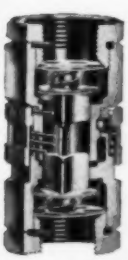
Snap-Tite

QUICK-CONNECT
QUICK-DISCONNECT COUPLINGS

in larger sizes

immediate delivery
FROM FACTORY STOCKS

Snap-Tite's "H" Couplings are now factory-stocked for quick shipment to you, not only in the smaller sizes (below 1" ID) but in all sizes up to and including 3"—in steel, brass, aluminum, and 303 and 316 **Stainless Steel.** And "H" Couplings can be made to your order, up to 10" ID.



Available with valves to give two-way or one-way automatic line shut-off, or without valves for straight-thru flow, "H" Couplings are built to handle high pressures in hydraulic and air systems.

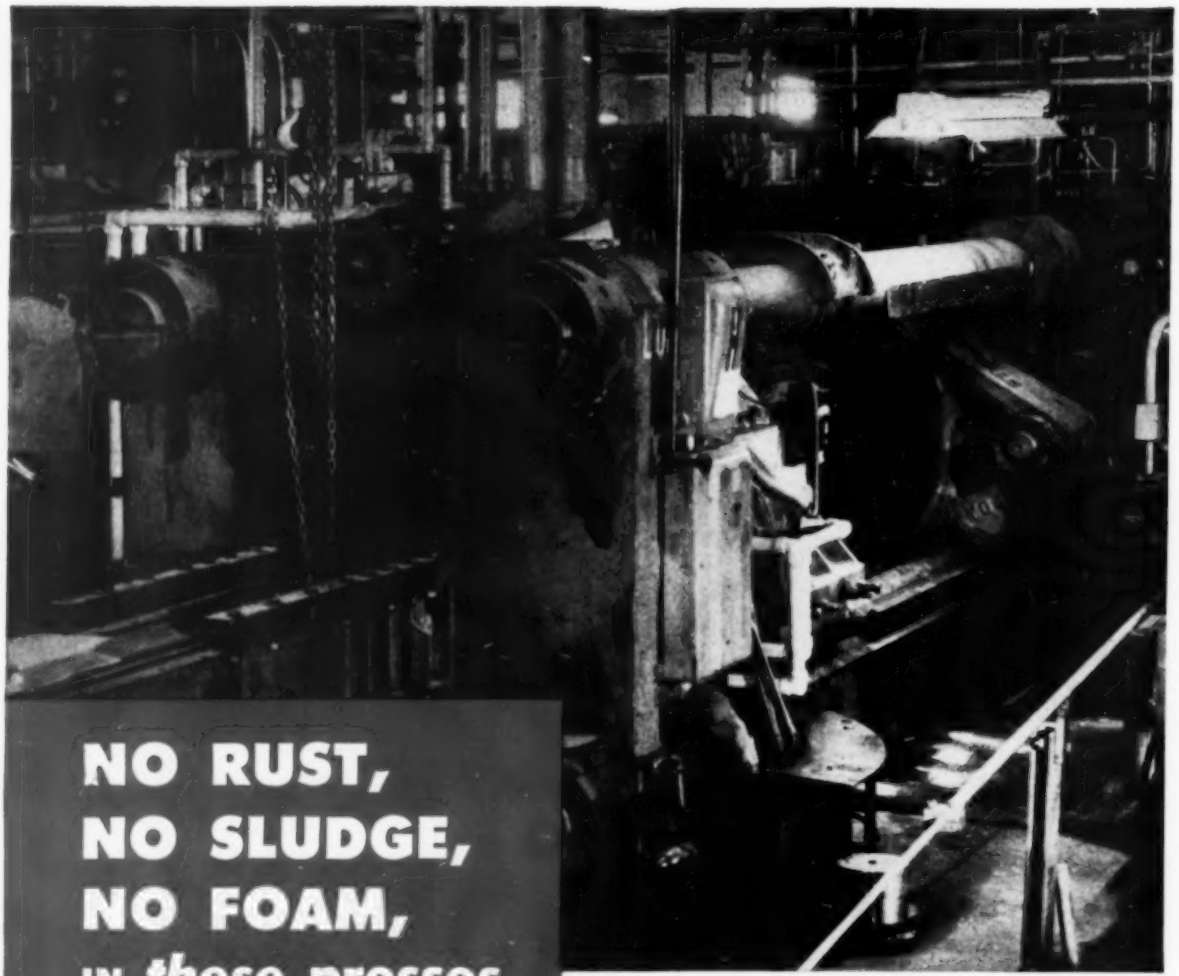
Recessed valve washers . . . fluted valve stems . . . valve stops with minimum flow restrictions . . . large inside diameter—allow maximum flow capacity with lowest pressure drop.

See the Snap-Tite representative in your city or write for Bulletin 240.

SNAP-TITE'S "H" COUPLING, SIZE FOR SIZE, IS THE SMALLEST COUPLING WITH HIGHEST STRENGTH AND HIGHER EFFICIENCY

Snap-Tite, INC.
UNION CITY 1, PENNSYLVANIA

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS



NO RUST, NO SLUDGE, NO FOAM, IN *these* presses

In this plant (name on request) there are four heavy duty extrusion presses. Hydraulic fluid in all of them has been *Texaco Regal Oil R&O* for over eight years—during which time systems have remained *completely free from rust, sludge and foam.*

This experience is typical wherever *Texaco Regal Oil R&O* is used in hydraulic systems. *Texaco Regal Oil R&O* has *more than ten times the oxidation resistance* of other high grade hydraulic oils—proven ability to prevent sludge, rust and foam. It adds up to smoother, more dependable hydraulic operation, longer life for pumps and other parts, lower maintenance costs.

There is a complete line of *Texaco Regal Oils R&O* to meet the requirements of every type and size of hydraulic mechanism, every operating condition. Let Texaco Lubrication Engineering Service help you select the proper one.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils R&O

FOR ALL HYDRAULIC UNITS

Announcing

THE 1956 AWARD WINNERS

APPLIED HYDRAULICS sponsors a contest every year which offers all readers the opportunity to submit an article. On the following pages award winners are announced and the top, three papers are published. During coming months, other papers winning cash awards and given honorable mention will be published. These papers represent successful designs, applications, and operating techniques. Each entry was evaluated on the basis of practicality, economic value, originality and presentation.

Judges for the 1956 Contest were: **H. A. Campbell,** Head of General Engineering Laboratories, Bell Aircraft Corp.; **F. C. Schuster,** Chief Engineer, Industrial Truck Div., Allis-Chalmers Manufacturing Co.; **J. J. Yates,** Electric and Hydraulic Engineer, Detroit Diesel Engine Div. General Motors Corporation.

First
AWARD PRIZE
$500

E. L. DIX

PAUL MAKER

E. L. Dix, Project Engineer, Bryant Chucking Grinder Company, Springfield, Vermont, and **Paul Maker,** Staff Engineer, Bendix Research Laboratories, Detroit, Michigan. "How to Apply Closed Loop Hydraulics to Machine Tools"

Development, selection and application of a mechanical-hydraulic servo system for an internal grinder are thoroughly analyzed. Reduced cycle time, greater accuracy and improved finish are the results of this work.

Second
AWARD PRIZE
$300

ROBERT E. RAYMOND

Robert E. Raymond, Project Engineer, Simplex Engineering Co., Zanesville, Ohio. "New Ideas for Pressure Control"

Accurate and stable control of pressure throughout a variety of operating conditions is often required. Mr. Raymond presents a practical approach to high fidelity pressure regulation. Taking well known control components he develops a valuable theory called derivative responses.

Third
AWARD PRIZE
$200

I. LEONARD KAPLAN

I. Leonard Kaplan, Chief Engineer, Lax Industrial Products, Inc., Cleveland, Ohio. "Proper Use of Relief Valves"

Practical circuits which are being used on hundreds of hydraulic applications show the proper use of relief valves to avoid shock and heat. This analysis covers basic considerations aimed toward greater efficiency from hydraulic systems in all types of industrial machinery.

Fourth-Seventh Prizes

$50 EACH

James Tankard, Design Engineer, Zagar Tool, Inc., Cleveland, Ohio. "Synchronization of Cylinders"

Four cylinders move a 40 in x 60 in table carrying the work piece vertically into a multiple drill head. Load on each cylinder varies considerably. With a special control cylinder, the platen can be held parallel within 1/64 inch across its 60 inch dimension. Hydraulic circuit powers a table on which 400 holes are drilled in one pass. Thrust load is 25,000 pounds.

Emil Struharik, Methods Engineer, McDonnell Aircraft Corporation, St. Louis, Missouri. "Control of Contaminants from Air Compressors to Aircraft Pneumatic Systems"

A successful program of removal of water, oil and desiccant dust before they can contaminate an aircraft system is described. Desiccant selection, dehydration piping, and air compressor modification are explained.

Theodore J. Mapes, Project Engineer, Eastern Industries, Incorporated, Hamden, Connecticut. "An Electro-Hydraulic Oscillator"

A system to impart an oscillatory motion to a large mass, such as a radar scanning antenna dish is described. Flow from a small hydraulic power package to the output piston is controlled by a servo valve. Computation of the resonant frequency for a system is presented.

E. B. Porter, Supervisor, Design Section, Research and Development Div., Vickers, Incorporated, Detroit, Michigan. "Circuit Development of a Spring Test Machine"

In the design of a system to give a life test on elliptical vehicle springs motion control problems were solved. The techniques described are applicable to machine design in general. Application of an electronic servo control is analyzed.

Honorable Mention

L. E. Erickson, Pipe Machinery Co., Wickliffe, Ohio. "Design of a Pipe Transfer Table"

R. I. Sinclair and D. E. Turnbull, Bedfordshire, England. "Compensating Static Reaction Forces of Spool Valves"

Addison T. Smith, The Airoyal Company, Maplewood, N. J. "High Speed Transfer Using Fluid Power"

Richard Witcomb and Theodore Mapes, Eastern Industries, Inc., Hamden, Connecticut. "Miniature Hydraulic Power Supplies for Aircraft"

Sanford Ellis, George M. Pearse & Co., Newark, N. J. "A Program for Experimental Hydraulics"

William P. Bartz and Robert J. Sem, Kearney & Trecker Corporation, Milwaukee, Wisconsin. "Sequence Chart for A Special Machine Tool"

E. J. Parker, Linear, Inc., Philadelphia, Pa. "The O-Ring's Place in Industrial Packing"

A. M. Knorr, Leeds & Northrup Co., Philadelphia, Pa. "Automatic Drilling, Tapping and Burr Removing Machine"

Joseph L. Poggie, Republic Aviation Corp., Farmingdale, New York. "Cushioning Short Stroke Hydraulic Actuators"

Robert J. Shrader and Joseph F. Weinum, Bowen-McLaughlin-York Inc., York, Pa. "Design of a Heavy Duty Hydraulic Level Wind"

Robert Spurr, Canadair Ltd, Quebec, Canada. "Inside a Spool and Sleeve Valve"

Peter Coffaro, Avey Drilling Machine Co., Cincinnati, Ohio. "Advantages of Manifold Mountings"

Paul R. Walton and William F. Morgan, National Acme Company, Cleveland, Ohio. "Hydraulic Duplicating Lathe"

Ora L. Sams, Carrier Corp., Monrovia, California. "Air-hydraulic Tube Welding Machine"

Edward M. May, Mayson Mfg. Co., Detroit, Michigan, "How We Designed a Packing"

L. H. Smith, General Electric Company, Schenectady, N. Y. "High Temperature Hydraulic Test Table"

PAUL MAKER
and E. L. DIX

How to apply . . .

CLOSED LOOP HYDRAULICS

. . . to machine tools

- Improve response to reduce cycle time
- Reduce operating force to improve accuracy
- Control vibration to improve finish

. . . these goals were accomplished on an internal grinder by using a hydraulic servo to power and control feed.

WHEN development of a precision feed system for an internal grinder was first undertaken, it was thought that any application involving servos would lead to a more expensive machine and that a much higher level of skill would be required in order to maintain such machines.

In practice, the contrary has been true. As a result of this development work, three commercial designs have been developed. The designs are notable for their simplicity and ease of manufacture.

Upon completion of the prototype machine, a ball bearing part was chosen for test purposes and comparative tests were run on an older machine and the new machine using the same fixture, workhead and wheelhead for both series of tests in order to render the results as nearly comparable as possible. The performance charts, Figure 1, show the best performance obtained from the uncontrolled machine in both cases. By uncontrolled, we mean that, after set-up, no gages were used, so that the results represented the machine's basic capability. Also, no adjustments were made during the test runs. The runs plotted are typical. The new machine has a much narrower distribution than the old; there is almost 50 percent improvement in surface finish, and the total grinding time per piece is approximately 1/3 that attainable on the older machine.

While the improved hydraulic system is not the only factor responsible for improved results, there can be no doubt that it contributes substantially to the machine's performance.

SOME INITIAL CONSIDERATIONS

As the requirements for precision increase in stringency, it becomes more and more necessary

to examine each component in a system as to its part, and that proper consideration be given the system as a whole. In particular, since the least vibration is desired, the natural frequency must be considerably greater than the operating frequency; not only the operating frequency of the machine, but also any frequency which may be induced by the machine's operation or which might normally be expected from the machine's environment.

Any real mechanism is subject to deflections and the vibrations caused by the deflections. However, there is no guarantee that all possible mechanisms for accomplishing a given result will deflect equally when subjected to a given service; and indeed, it would be surprising if this were true. It follows then, that the design engineer's task, in part, is to examine the various techniques and methods at his disposal and select and integrate those which, in the light of experiment and experience, seem to afford the maximum system stability. There are certainly other criteria but, it will be seen that a superior solution of the stated problem tends to satisfy most other criteria.

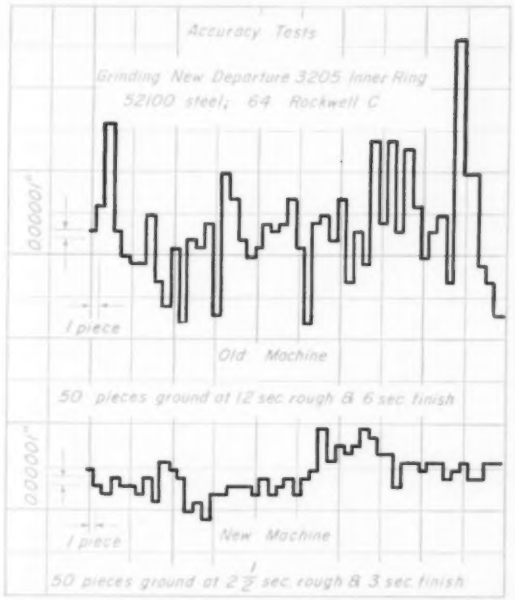

Accuracy Tests
Grinding New Departure 3205 Inner Ring
52100 steel; 64 Rockwell C
.00000"
1 piece
Old Machine
50 pieces ground at 12 sec. rough & 6 sec. finish
.00000"
1 piece
New Machine
50 pieces ground at 2½ sec. rough & 3 sec. finish

FIG. 1. Performance charts compare the accuracy between the old and new machine using a closed loop hydraulic system.

STUDY OF ALTERNATE FEEDS

To illustrate, let's examine a single motion, the traverse of a grinding machine wheelside; and discuss a lead screw drive; a cam and lever drive; an open ended, hydraulic system; and a proportionally controlled hydraulic cylinder with feedback from the slide.

A recurrent problem in machine design is to obtain a motion of a mass involving relatively high velocities, accelerations, reversals, and precise positioning. In general, in the past, only partial solutions were obtained. In the case of the lathe, lead screws are used to obtain the required positional accuracy; and high velocity and ability to reverse quickly are sacrificed. Various other types of machines use cam and lever system and are able to reduce cycle time at the expense of accuracy. Still other machines use open-ended hydraulic systems which often give great flexibility in set-up and operation but with still a greater loss in positional control.

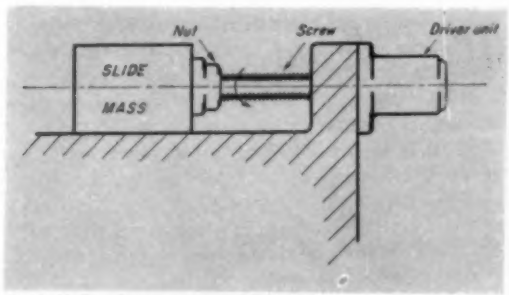


FIG. 2. Lead screw controlled slide

In Figure 2 a lead-screw and nut driving a slide is shown. While the lead-screw delivers a force along its own axis, which is highly desirable, there must be, due to friction between the lead-screw and nut, a torsional component which can have no useful effect on the machine and will, in most cases, have a harmful effect. Furthermore, the

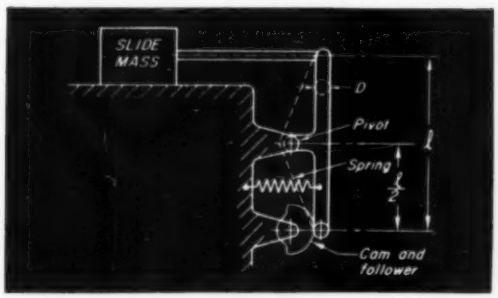


FIG. 3. Cam and lever controlled slide

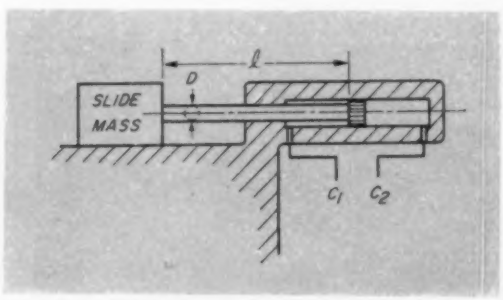


FIG. 4. Hydraulic cylinder controlled slide

CLOSED LOOP HYDRAULICS

lead-screw is almost, of necessity, self-locking which implies that rapid changes of acceleration cause very large forces to arise with accelerated wear and reduced reliability. The mechanical problems which arise in attempting to obtain reversals with these systems lead to very expensive solutions which often have excessive mechanical bulk.

In Figures 3 and 4, two systems are compared. In each, a force is transmitted through a lever of circular cross section and length "L". In the first case, the force is derived from a cam and the lever becomes a column and is loaded as a beam in bending. In the second case, the lever is loaded by a piston in a hydraulic cylinder and is, therefore, in tension or compression. Figures 5 and 6 analyze the deflections and natural frequencies of the two systems. Writing the equations for the lever loaded in the two different manners, gives equations 1 and 2; and dividing, gives equation 3 which expresses the ratio of deflections in the two systems. Similarly, equation 9 describes the ratio of the natural frequencies of the two systems. In both basic equations the force is taken as that necessary to accelerate a given mass an equal amount.

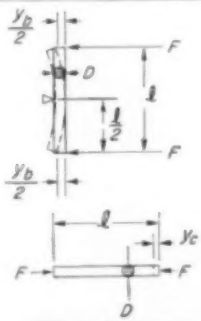
This analysis leads to the conclusion that given a choice of mechanisms or structures, we should avoid, insofar as is possible, using them as levers or creating leverages across them. The bar of circular cross-section in Figure 3 does not represent the most efficient use of the material; however, if we wish to increase the relative stiffness of this rod by as little as a factor of 10 to 1, it will be necessary to add a considerable amount of material near the pivot while, if equal additions be made to the rod used in compression, the ratio would increase again; therefore, in practice the ratio between the two systems will always be large. This analysis leads to the conclusion that an efficient use of structure and material lies in the hydraulic cylinder and an extension of these ideas leads to the further thought that the line of thrust should pass as nearly possible through the center of gravity of the mass which is to be driven.

OPEN VS CLOSED LOOP CIRCUIT

Available means of signalling open ended and closed loop circuits must be examined. In an open loop hydraulic system, the velocities attained by the driven mass are controlled by the pump characteristics, the resistance of the connecting lines and such throttles or other restrictions as may be in the system. Since such systems are commonly controlled by on-off type valves which are tripped by the slide itself at either end of its stroke; if any great velocity is obtained, in order to reverse smoothly it is necessary to add auxiliary devices which will govern the rate of change of the flow of the hydraulic medium when the tripping of the valve calls for a reversal of motion. These auxiliary devices are, in general, overly sensitive to ve-

Nomenclature

D	= diameter lever or rod	in.
l	= length	in.
F	= force	lbs.
E	= modulus of elasticity	
I	= moment of inertia	
A	= area	Sq. in.
y_b	= deflection in bending	in.
y_c	= deflection in compression	in.
ωb	= frequency in bending	
ωc	= frequency in compression	
ωn	= natural frequency	
K	= system spring constant	



$$y_b = 2\frac{F\left(\frac{l}{2}\right)^3}{3EI} \quad \text{---(1)}$$

$$y_c = \frac{Fl}{AE} \quad \text{----(2)}$$

$$\frac{y_b}{y_c} = \frac{l^2 A}{12 I} \quad \text{----------(3)}$$

$$A = \frac{\pi D^2}{4} \quad \text{----------(4)}$$

$$I = \frac{\pi D^4}{64} \quad \text{----------(5)}$$

$$\frac{y_b}{y_c} = \frac{l^2\left(\frac{\pi D^2}{4}\right)}{12\left(\frac{\pi D^4}{64}\right)} = \frac{4}{3}\left(\frac{l}{D}\right)^2 \quad \text{--------(6)}$$

FIG. 5. Deflection formulae

Let K = system spring constant, which for equal forces is inversely proportional to the deflections

$$\text{then } \omega_n = \sqrt{\frac{K}{m}} \quad \text{----------7}$$

$$\text{and } \frac{\omega_c}{\omega_b} = \frac{\sqrt{\frac{K_c}{m}}}{\sqrt{\frac{K_b}{m}}} = \sqrt{\frac{K_c}{K_b}} = \sqrt{\frac{y_b}{y_c}} \quad \text{----8}$$

$$\therefore \frac{\omega_c}{\omega_b} = \frac{1}{D}\sqrt{\frac{4}{3}} = 1.154\frac{l}{D} \quad \text{---------9}$$

$\frac{l}{D}$	$\frac{y_b}{y_c}$	$\frac{\omega_c}{\omega_b}$
1	1.33	1.154
2	5.33	2.308
3	12.00	3.462
4	21.30	4.616
5	33.30	5.773
6	48.00	6.924
7	65.30	8.078
8	75.30	9.232
9	108.00	10.386
10	133.33	11.540

FIG. 6. Frequency formulae and chart

locity and are hard to adjust. It becomes increasingly difficult to obtain such devices—which are commonly called "cushions"—which will work well in terminating both long and short strokes. Often desirable short strokes cannot be obtained due to the limitations of these mechanisms.

No such mechanisms are required in a closed-loop system since the system is constantly seeking to reduce the error which is translated as a valve position, to zero through a feed back means; and, consequently, the acceleration is proportional to such error and the system can discriminate between high and low velocities and high and low accelerations.

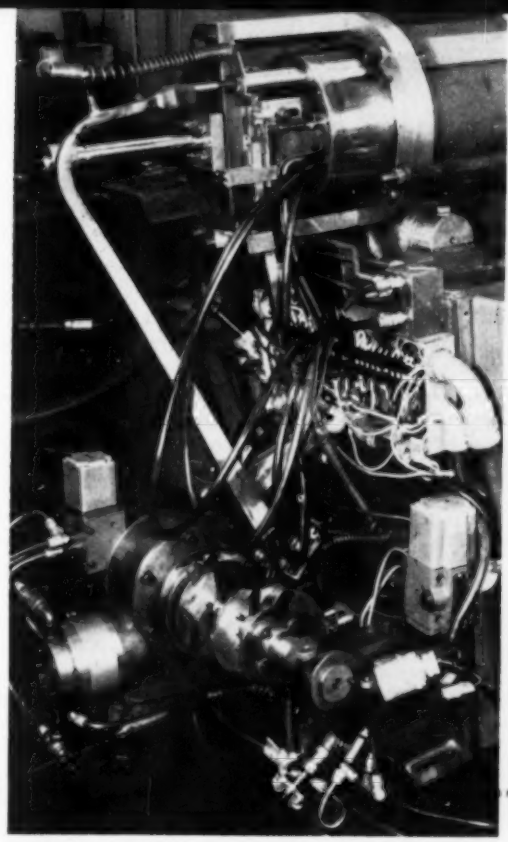
In the system to be described, the cam is retained as a signalling element; for while it is not generally recognized, cams are usually applied in such a manner that they have two functions—one being to apply power to a system and the other being to furnish positional control. In general the cam does not give a good account of itself as a power element since, as it is almost necessary

Continued on next page

APPLICATION ON A GRINDER

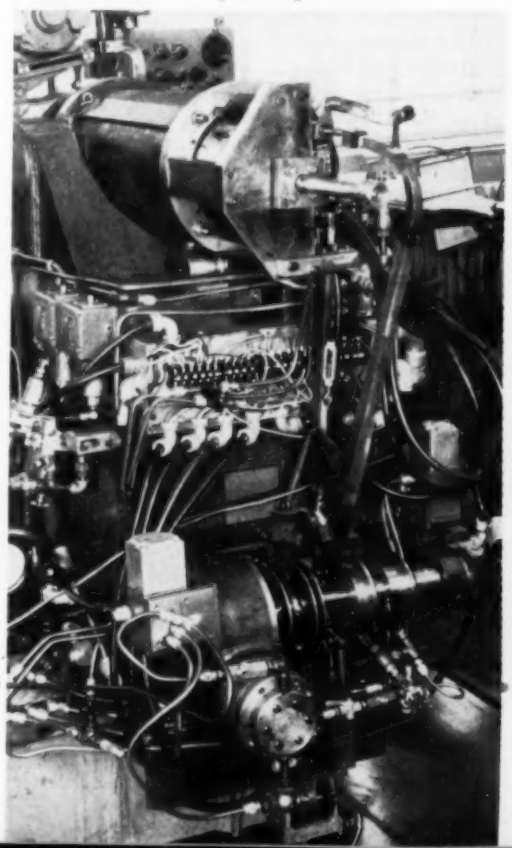
This experimental machine uses the closed loop hydraulic system. A cam shaft, located on the lower-left hand end of the bed, is rotated by a hydraulic motor and a worm gear reduction which provides a drive of considerable flexibility. The motor is a piston type motor using balls for pistons and is a compact unit of high efficiency. The cam shaft itself is supported at its right-hand end in a conventional live center, this being possible due to the light loads on the cam shaft. When it is desired to change cam shafts, the live center may be retracted and the cam shaft may be lifted out and replaced by another—the whole operation taking less than a minute.

The large goose-neck lever, connected to the slide at one end for positional feedback, has the master cam follower on its other end. These two signals are summed at an intermediate pivot and fed through another lever to the servo valve. The second lever serves as an additional input on certain models of the machine. The drive cylinder is approximately concentric with the cylindrical slide and has the valve block gasketed to it. The hydraulic tank is partially under the machine which rests upon the tank and the tank extends far enough to the rear so that the pump and its drive motor may be mounted upon the tank to simplify piping and hydraulic arrangement.



FRONT view of research machine. Piston type fluid motor drives the cam shaft.

LEFT end of the machine. Cam shaft is mounted between centers for quick replacement.



to use a lever system with the cam, we suffer from the disadvantages previously described; and furthermore, unless we wish to use complicated cams, we find ourselves forced to restrain the follower against the cam by the use of a spring so that the cam drives in but one direction while the spring drives in the other. This means that when the cam is driving, it is also loading the spring so that it may furnish the necessary power over it's portion of the cycle.

The cam, however, as an input device, compares well with any other in common use. A great deal of information can be placed on a single cam with a good degree of accuracy and, if we can accept the limitation of sequential presentation of the information, we find that ease of access is good and that permanence of information storage is excellent. It is interesting to note that two cams on a single cam shaft may be considered as being able to store much more than twice as much information as one cam due to the fact that not only the positional output of the cam may be regarded as information, but also the point to point angular relationship between the two cams.

CLOSED LOOP CONCEPT

Figure 7 shows a schematic of the hydraulic closed loop circuit developed to power a machine tool slide. This hydraulic system is signalled by one or more cams. The signal is fed through a summing lever system to the servo valve. Motion of the machine slide is provided by the hydraulic cylinder. This motion is fed back through the linkage to achieve a positional control of the output. This is a description of a mechanical-hydraulic servo mechanism used as a power amplifier.

In Figure 8 the system equations are given: 1. the equation expressing the performance of the valve; 2. the continuity equation of the ram; 3. the dynamic equation expressing the relationship between the mass, its acceleration and the forces available to move it; 4. the equation of the driving linkage. Figure 8 shows these equations expressed as simplified block diagrams and Figure 9 shows these combined into a single system block diagram.

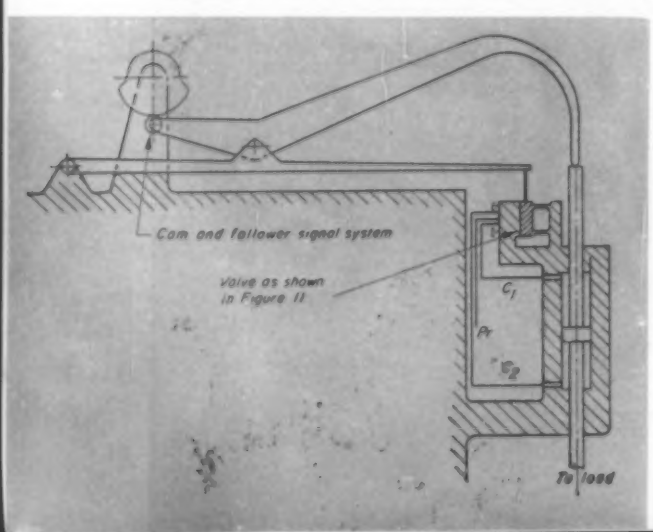


FIG. 7. Mechanical-hydraulic servomechanism

The system characteristics can be calculated and determined from this set of equations, but there is a technique available which is highly graphic and allows a wide degree of latitude in manipulation of the parameters involved. This technique is to simulate the system by means of an analog computer; and this particular system was set up on a Philbrick computer which was assembled from modular elements. Figure 10 shows response traces of the system with some variation of the parameters involved. Figure 10a being an underdamped trace which would represent a system too oscillatory for our purposes. Figure 10b shows a system with a higher degree of damping but still more oscillatory than desirable. Figure 10c shows the parameters as actually chosen and represents a good compromise of the various factors involved.

The trace shown represents the response of the system when excited by a step function and shows a certain amount of over-shoot beyond the desired value expressed by the step function. The choice of a step rather than a sinusoidal exciting function was due to the desire to assure minimum response time and to design on the basis of a more severe service than the machine would experience in operation. The response and over-shoot ratios are independent of the magnitude of the step. The over-shoot is incorporated in the system in order to reduce the time of response and make the system more sensitive. It can be seen in Figures 10a and 10b that the response is somewhat faster, but that when any real gain is attempted over that represented by Figure 10c the system tends to pass into oscillation.

In practice, the system parameters are set on control knobs on the computer element cases so that they may be varied readily when examining a potential solution.

DEVELOPMENT OF SERVO VALVE

A factor which has held up in the development of servo systems for machine tools has been the difficulty of designing and manufacturing valves of suitable accuracy. While such valves have been made, they have, in general, been very expensive and difficult to make. However, a design, developed and patent applied for by Professor S. Y. Lee of MIT goes far toward solving the problems involved in making very accurate valves. One of these valves is shown in Figure 11. A channel is formed in the movable plate. This plate, when assembled to the stationary plate, is drilled in such a way as to intersect the channel, and then plugs are inserted in the holes in the movable plate so that the channel is separated into three sections. The edges of the plugs form metering edges where they interrupt the channels in the same manner as the lands on

Nomenclature

A = ram area	in^2
y = displacement of ram	in
M = load mass	lb sec ^{2}/in
Q = flow to ram	in ^{3}/sec
P_l = pressure across ram	lb./in.^{2}
Z = valve displacement	in
K_1 = valve characteristics	in ^{2}/sec
K_2 = leakage flow characteristics	in ^{5}/lb. sec
K_3 = fluid compressibility	in ^{5}/lb
K_4 = feed back ratio	
b = viscous load damping	lb sec/in
X = input signal	in

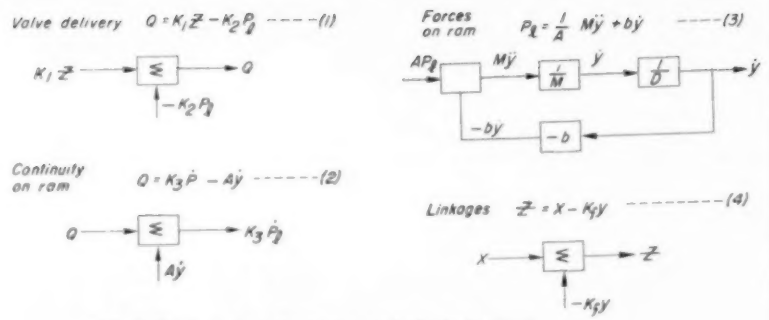


FIG. 8. Basic system formulae and block diagram

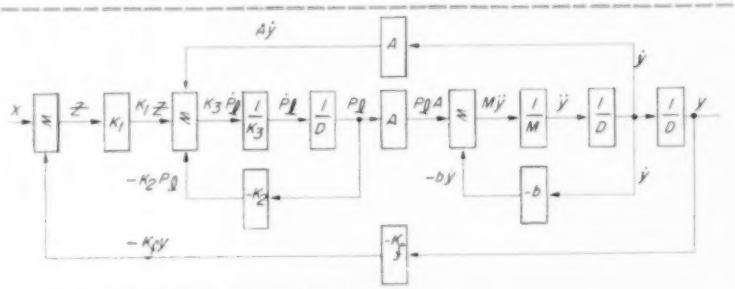


FIG. 9. Combined system block diagram

a conventional spool valve. However, due to the construction, the edges of the plugs and the edges of the holes in the base plate are line to line and this condition does not depend upon measurement. The movable plate is part of a block which is formed and slotted in such a way that the movable plate is suspended on a reed system. If the mating surfaces are then ground flat and the surface of the movable plate lapped very lightly, the movable plate will have a positive clearance over the base plate and this clearance will be very small.

Such valves can be made comparatively rapidly and that their cost compares very favorably with that of a conventional spool valve. If, due to erosion or any other cause, the metering edges become worn, the two parts may be reground on their faces, lapped as before and reassembled. The valve will be restored to its original quality. ▼▼▼

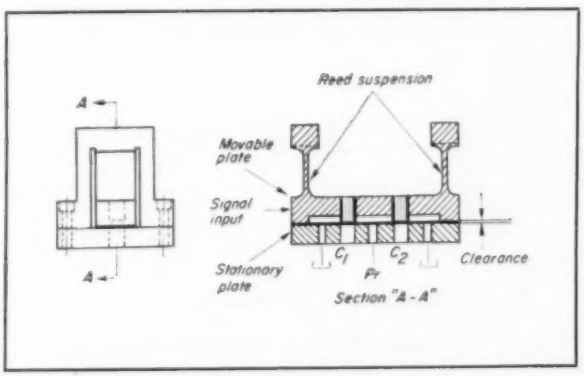


FIG. 11. Schematic of plate, plug type valve

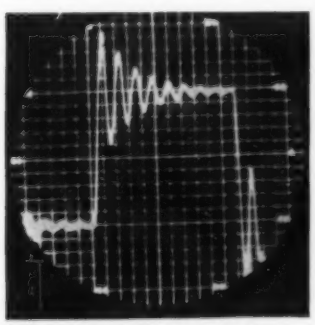


FIG. 10a. System in oscillation

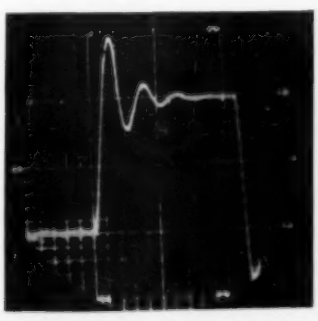


FIG. 10b. Insufficient damping.

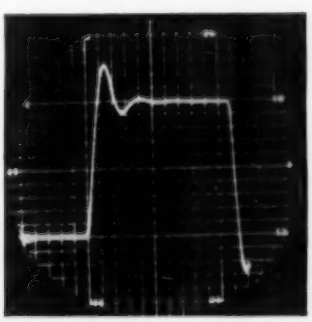


FIG. 10c. With optimum damping

SECOND

PRIZE

ROBERT E. RAYMOND

NEW IDEAS FOR PRESSURE CONTROL

. . . on oil hydraulic equipment

- Why do some relief valves squeal and chatter?
- How can shock pressures be controlled?
- Small control orifices often fail because of dirt. Can they be eliminated?
- What control set-up will provide fast response of a pressure compensated pump?

From a practical standpoint the pressure derivative techniques outlined in this analysis can be employed with almost any standard differential relief valve by tapping into the pilot section with the proper sized accumulator. Most variable displacement pumps are adaptable to derivative modifications. Use of balanced spool valves, orifices, and accumulators of standard designs can be utilized to accomplish many unique phase lag and phase lead effects that could be useful in improving standard valve performance as well as providing a powerful tool in hydraulic servo problems.

HIGH fidelity pressure regulation can be obtained by using the techniques of derivative responses. To facilitate the development of this theory, two fundamental types of proportional pressure control devices (relief valves) represent the broad problem. These two valves are illustrated in Figure 1. Figure 1a shows a direct spring operated spool which must handle the full line pressure as well as the rated valve flow. Figure 1b represents the well known differential or compound valve employing a balanced pressure condition to control the main spool.

The direct spring operated spool inherently possesses high frequency characteristics but poor pressure-flow regulation. Quick response stems from the high force-to-mass ratio present in conjunction with the high energy stored in the spring. This also gives rise to instability and chatter tendencies. The poor steady pressure-flow regulation primarily results from spring-rate limitations when handling large forces directly with the spring. Many of the weaknesses of the simple direct spring device are

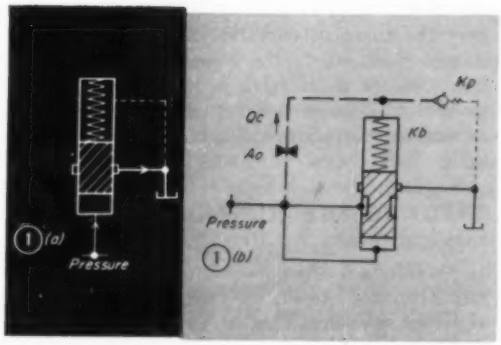
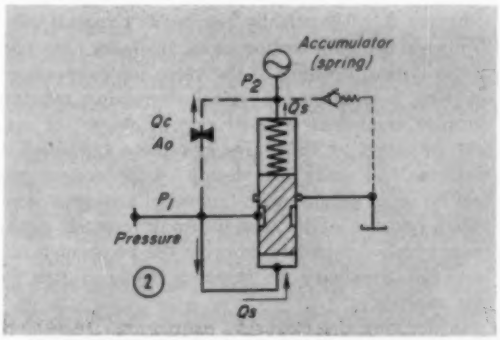


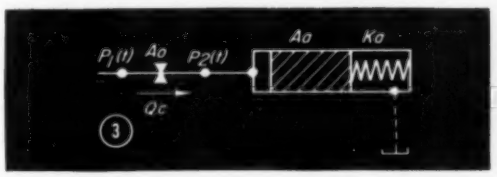
FIG. 1a. Direct spring operated spool. Response is proportional to pressure.

FG. 1b. Differential relief valve. Response is proportional to pressure

FIG. 2. Rate compensated differential valve. Pilot capacity limits pressure overshoot due to sudden flow into valve.

FIG. 3. Orifice-accumulator combination creates orifice pressure drop as a function of time.





corrected by the differential valve. The high energy spring is eliminated and a low energy pressure balance is made to control the main spool. Extremely low pressure-flow variation is achieved due to the high spool forces attained from the pressure differences set up by the sensitive control orifice. In effect, the pilot section needs only to handle an extremely low flow which necesitates a very low energy control spring at the small control poppet. In addition, this control flow remains relatively constant as the main spool handles the major portion of total flow. The spool is thus retained by highly flow-sensitive orifices enabling large forces to be developed to obtain extreme steady-state accuracy. This result is not accomplished without sacrifice.

Arrangement of the orifice control resists high rates of change of the main spool position. Actually, this damping effect eliminates squeal and noise due to high frequency, low amplitude, pressure waves that cause the extreme acceleration-deceleration effects at the main pressure relief orifice. The difficulty remaining is that the main spool is so critically damped that it cannot accept a sudden surge flow and limit the pressure below the control setting. In short, the differential valve will inherently create a shock pressure considerably above the steady-state pressure setting if it is forced to suddenly accept a high flow rate due to rapid valve closure, etc., in the system. It is evident from Figure 1b that the control section would have to handle the full surge flow into the valve for the small time interval that is required to open the main spool sufficiently. In addition to this condition, it is also apparent that the low energy bias spring on the main spool must work against the control orifice in returning the spool to steady-state position. This results in sluggish recovery.

ADDING DERIVATIVE RESPONSE

Figure 2, illustrates a differential valve capable of high frequency response. A small capacity accumulator is used in the pilot section of the valve. Since the accumulator need handle only the displacement of the valve it can be very small, subject to other design criteria. During a gradual or relatively slow change in system pressure P_1 the control orifice furnishes oil to the pilot chamber de-

NOMENCLATURE

X	=	Distance
A	=	Area
P	=	Pressure
K	=	Spring rate (Force/Distance)
t	=	Time
V	=	Volume
Xo	=	Maximum valve spool movement
$P_1(t)$	=	Instantaneous primary system pressure
$P_2(t)$	=	Instantaneous pilot section pressure
$\triangle Pc$	=	Critical orifice pressure drop
$\triangle Ps$	=	Surge pressure rise resulting from rapid valve movement
Pp	=	Accumulator precharge pressure
Qc	=	Pilot section control flow rate
Qs	=	Surge flow rate
Aa	=	Piston Accumulator spool area
Ao	=	Control orifice area
Ab	=	Damping orifice area
Φ	=	Orifice discharge coefficient
C	=	Capacity (volume/pressure)
Ds	=	Spool diameter
Vm	=	Maximum accumulator volume
$\frac{d}{dt}$	=	Derivative notation—variation with respect to time
Ka	=	Accumulator spring rate (force/distance)
Kb	=	Bias spring rate
Kp	=	Pilot poppet spring rate

veloping P_2. The accumulator charges and rises sufficiently fast enough to retain P_1—P_2 below the critical magnitude Δ Pc which is determined by the main spool bias spring. At these conditions, the main spool remains closed and no by-passing action occurs.

Figure 3, schematically represents dynamic conditions in the pilot section at an arbitrary time just at the critical opening of the valve for purposes of deriving a simplified physical expression relating the maximum derivative or rate of change of system pressure to the valve parameters. Complete mathematical study and design of the system can best be accomplished with the use of analogue computers because of the non-linear differential equations which completely describe the physical problem. For simplicity we resort to basic criteria in this analysis.

In deriving the following expression, we neglect the mass of the accumulator parts and the contained oil in the pilot section as the dynamic effects of these quantities are negligible, compared to the frictional effects encountered in the pilot orifice.

Let ΔPc be the critical control orifice pressure drop above which the valve will begin to open.

Then $$P_1(t) - P_2(t) = \Delta Pc \quad \text{.....(1)}$$

and $$P_1(t) - P_2(t) = \frac{Qc^2}{Ao^2\Phi^2} \text{ (orifice theory) (2)}$$

also $$Qc = \frac{Aa^2}{Ka} \frac{dP_2(t)}{dt} \text{ (from spring accumulator) .....(3)}$$

Differentiating equation (1) we have:

$$\frac{dP_1(t)}{dt} = \frac{dP_2(t)}{dt} \Delta Pc = \text{constant} \quad \text{..(4)}$$

Therefore $$\frac{dP_1(t)}{dt} \text{ (critical)} = \frac{Qc}{C} = \frac{KaAo\Phi}{Aa^2} \sqrt{\Delta Pc} \quad \text{....(5)}$$

Equation (5) represents the critical rate of change of system pressure that can be sustained without valve opening. The maximum rate of change of pressure that can be sustained is equal to the ratio of the valve control flow to pilot capacity. Higher rates of change would begin to open the valve ahead of the pressure setting in the pilot section. This phenomenon means that the valve senses or detects the rate of change of pressure and acts to begin opening the spool ahead of the pressure setting of the pilot section poppet if the rate is critical. Therefore, the addition of the pilot accumulator performs an integration of the parallel flow rate of the control orifice and spool movement and permits high transit flow rates, Qs to short circuit to the accumulator through the spool movement. This, of course, opens the valve to relieve the transient condition. This set of circumstances does satisfy the basic requirements of a true pressure relief valve in that it must be able to accept a surge flow of the valve rating by capacitive absorption during the transient opening time.

SELECTING THE ACCUMULATOR

Choice of accumulator size for an arbitrary set of conditions is dependent on the permissible pressure. Overshoot versus the tolerable rate of change of system pressure. This, at best, is a compromise. Use of a spring type capacity or accumulator illustrates a typical design procedure. In practice, a spring accumulator is practical since the capacities required are relatively small. However, gas accumulators are also applicable.

For a spring accumulator the expression for the capacity is:

$$C = \frac{Aa^2}{Ka} \quad \text{.....(6)}$$

The maximum spool movement capable of handling the rate of valve flow at a nominal pressure drop is Xo. Therefore, the maximum main spool orifice area is πDsXo. The required spool movement is a minimum if the spool has zero lap or if the spool actually has a poppet seat. This reduces capacity requirements.

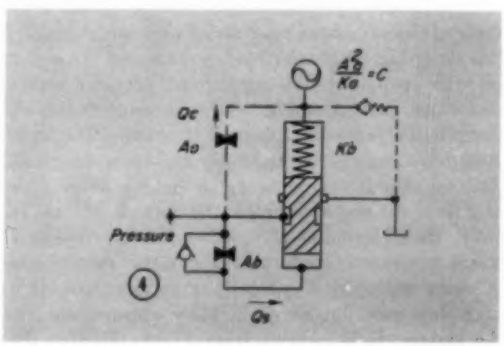


FIG. 4. Damped rate compensated differential valve. Accumulator accepts surge and orifice Ab restricts recovery.

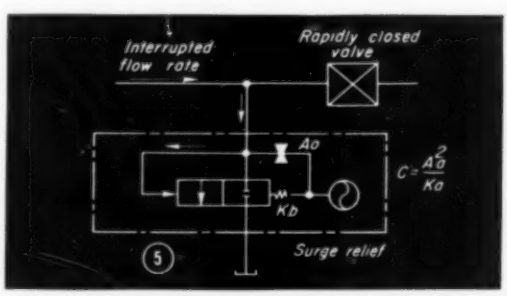


FIG. 5. Rate sensitive surge supressor. Rate of pressure change is limited by the by-pass valve.

The general expression for the required capacity to limit an instant surge pressure to ΔPs is:

$$C = \frac{\pi D_S X}{\Delta P_S} \qquad (7)$$

A plausible criteria for determining Δ Ps is to use Δ Pc or the main spool biased pressure since the final steady state pressure is always Δ Pc above the control section setting. However, this is arbitrary and subject to individual requirements. Although the spool movement can actually be smaller at higher pressures it is safe design to use Xo in keeping with the wide pressure conditions obtainable with the differential type valve. Therefore, the general design criteria for the pilot accumulator can be:

$$\frac{A_a^2}{K_a} = \frac{\pi D_S X_o}{\Delta P_c} \qquad (8)$$

If we were to use a gas accumulator the *adiabatic* expression for capacity would be:

$$C = \frac{V_m P_p^{.71}}{1.4 P^{1.71}} \qquad (9)$$

Since the gas curve is essentially a non-linear function of pressure the accumulator capacity reduces as pressure increases. This characteristic of the gas accumulator actually is not detrimental due to the fact that the required spool movement is less at higher pressures.

Various effects can be obtained by adjusting the pre-compression or pre-charge of the accumulator. High pre-charge cancels the derivative detection unitl the system pressure equals the pre-charged value. If the pre-charge is adjusted to the maximum valve setting, high rates of change of pressure can be tolerated up to the valve setting. However, the capacity effect to accept surge is still present. This permits high rate of change of pressure without overshoot.

REDUCING CHATTER

Addition of the accumulator does not effect the steady state balance of the valve and in no way decreases the steady state accuracy of control. Since chatter or squeal could result from high frequency low amplitude waves, it is desirable to dampen the recovery response of the main spool safely under the critical chatter frequency. Such a scheme is illustrated in Figure 4. Free flow to open the spool accepts surge but orifice control restricts recovery within tolerable limits. Recovery time of the valve can be turned and could be considerably higher than the conventional proportional differential valve. This is true because the recovery orifice is independent from the control orifice and can be considerably larger. The energy stored in the accumulator delivers the power to return or close the spool when system pressure falls rapidly.

An additional advantage of capacity present in the control chamber is to create a local filtering effect on the control flow presented to the pilot control spring and poppet. This phenomenon minimizes chatter tendencies in the pilot control section due to higher harmonic flow across the pilot relief poppet. The result of the local filtering action permits higher control flows to be used which in turn permits larger control orifices, minimizing dirt problems. The local filtering also makes it possible to increase pressure ranges (within tolerance of accumulators) with resulting higher control spring energy, without inducing chattering. Basically, the filtering action tends to absorb high frequency and presents more of a DC flow to the control poppet.

DERIVATIVE DECELERATION CONTROL

To expand the principle of response to rate of change of pressure Figure 5 is used. Here the theory of derivative responses is used to handle the kinetic energy involved in flow lines interrupted by rapid valve closure.

By adding the derivative detective means in conjunction with a balance spool device, a valve is created which will open when subjected to high rates of pressure change. It is obvious that this phenomenon is associated with rapid deceleration of flows upon valve closures, etc. In Figure 5, if the system valve is instantly shut, the oil continues to flow into the accumulator through the spool movement. This action opens the valve and short circuits oil to the reservoir. The spool throttles the flow rate building up pressure uniformly to the main pressure setting of the system relief valve. This action eliminates high surge pressures at the valve and does so without storing energy. The primary action in decelerating the oil column is one of frictional resistance and the energy is therefore dissipated in the form of heat at the by-passing valve. This is obviously superior to direct methods of deceleration with an accumulator on the line, for it would be necessary to use a considerably larger accumulator in the latter case as well as deal with large stored energies in the system.

VARIABLE DISPLACEMENT PUMP CONTROL

One of the most significant uses of pressure derivative response is in the field of variable displacement pump controls. With conventional pressure compensated designs capable of wide pressure adjustment, the restrictions on the primary stroke bias spring are similar to those outlined previously for direct spring relief valves. The stroke mechanism bias spring must be designed to provide a stable force gradient, overcome friction, load force components, and have excess force available for acceleration of the stroke mechanism. This must be true over the entire pressure range. For the spring to satisfy these necessary requirements and also handle the primary pressure over wide ranges is prohibitive.

A popular practice is to provide a maximum pressure for stroke adjustment such as illustrated in Figure 6. The main line pressure is detected by a sequence valve A which transduces the system

pressure to a control flow which is reconverted to a reduced control pressure by orifice C. The reflected pressure is then fed back to the pump and adjusts the pump stroke against the bias spring. The function of the relief valve B is to limit the control pressure and absorb excess flow during transients. This relief can usually be the direct spring type because the pressure is low and the valve is not required to produce accuracy of pressure control.

Since the sequence valve can be of the differential type, wide pressure ranges can be attained with sharp pressure-flow characteristics similar to differential relief valve. The control orifice is small to reduce steady state power losses required to center the pump at maximum pressure, but should be large enough to allow some reasonable recovery rate for sudden flow demands. The orifice is therefore a compromise which may necessarily lean toward the conservation of power with the resulting sluggish recovery.

Two major shortcomings exist in the control outlined above:

1. The differential sequence valve is capable of shock during sudden surge flow commands.
2. The pump is seriously limited in its recovery rate when the system pressure suddenly drops commanding flow.

Figure 7 shows a possible rate compensated variable displacement pump making use of the derivative principles derived in the analysis above. The sequence valve (D) detector is compensated to accept surge input. Section (G) is the low pressure relief for limiting the feedback pressure. We neglect section (E) for a moment.

Assume that the pump is on minimum stroke maintaining system pressure at minimum power loss (orifice F is designed for stable operation at minimum power loss). If the system resistance suddenly drops, the detection valve closes instantly cutting the feedback power to the pump. The normal discharge of fluid flow from the pump bias spring through the control orifice would produce a semi-parabolic increase in stroke with the resulting time lag associated with this restriction. This is analogous to condenser-non-linear resistance discharge in electrical systems. At any rate, the sluggish recovery is due to the proportional complications of pure orifice control.

Addition of section (E) in the feedback control of the pump allows the control orifice to be bypassed during a rapid fall of the primary pressure. This is accomplished by detecting the system pressure at the spool control ports as illustrated in Figure 7. If the system pressure begins to fall at a rate equal to or greater than the critical derivative rate of the valve (section E), the stored energy in the accumulator moves the valve spool open and the pump bias spring discharges through the valve, by-passing the control orifice. It is apparent that this action allows the full bias spring force to be utilized to accelerate the pump stroke mechanism and move it to be an increased stroke position at a much higher rate than with orifice discharge alone. Thus the pump recovery is considerably higher with rate compensation.

Adjustments of rate compensation for increasing and decreasing pressure derivatives permits high frequency response of variable displacement machines without disturbing the low frequency or steady state range and accuracy of conventional proportional control.

Expansion of these techniques to similar applications is readily seen. The importance of these concepts cannot be over emphasized for modern high fidelity pump controls. ▼▼▼

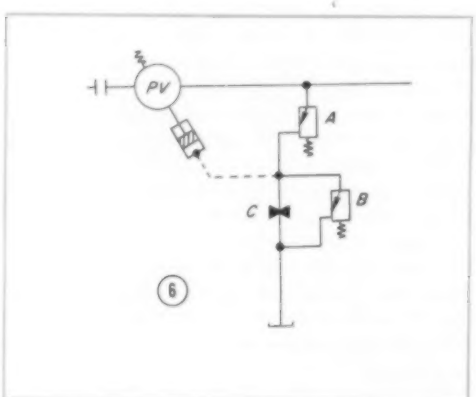


FIG. 6. Variable displacement control makes possible wide pressure adjustments. Stroke spring, operated by low pressure, permits practical spring design.

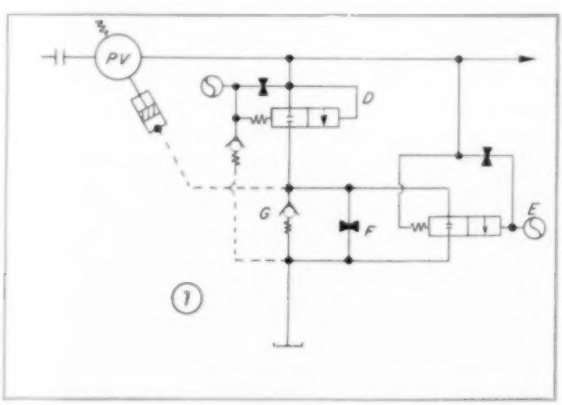


FIG. 7. Rate compensated variable delivery pump. Surge and recovery conditions are improved by the pressure derivative control sections.

THIRD PRIZE

I. LEONARD KAPLAN

Solutions to system troubles caused by shock and heat through.....

PROPER USE OF RELIEF VALVES

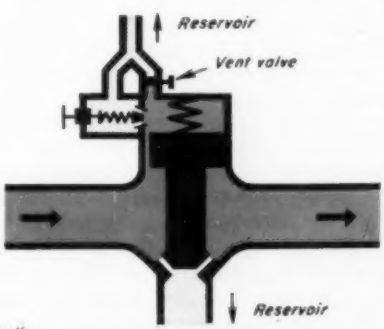
Undoubtedly, the two most serious problems with which the hydraulic circuit designer is confronted involve the generation of shock and heat. As circuits are designed to meet greater and greater horsepower requirements, the likelihood that shock and heat will be present is more and more assured.

The most common solution to the heat problem is to add a water-cooled heat exchanger to the system. The most common solution to the shock problem is to add accumulators or other shock-absorbing devices. These solutions often complicate the hydraulic circuit, add to the initial expense, and increase the maintenance required on the given machine.

It becomes necessary, therefore, to design into high power circuits operational features which will cut down the generation of heat to the point where the excess may be transferred without additional cooling components, and control principles which will eliminate the generation of hydraulic shock at its source.

Pilot operated relief valve . . . Greater utilization of the design features of the ventable or pilot operated relief valve can reduce system problems caused by heat and shock. This construction is available from several hydraulic valve manufacturers in sizes from $\frac{3}{8}$ inch to 2 inch pipe. These valves are suitable for flows up to and including 120 gallons per minute.

The control feature built into this valve which is of the greatest importance to the elimination

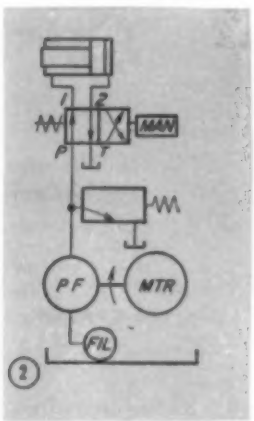


PILOT OPERATED RELIEF

of excess heat in a given system is that the main spool will open when the vent port is allowed to drain directly to tank and will allow the flow directed to the pressure inlet to bypass directly out of the tank port with very little resistance. In utilizing this bypassing ability, it is important to follow the manufacturer's recommendations in sizing of the valve and lines for a given flow.

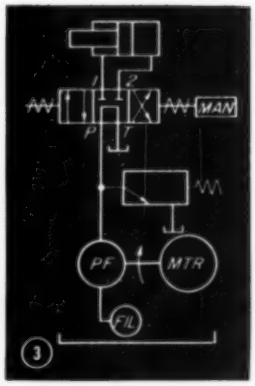
The orifice which interconnects the pressure port to the pilot head and differential area of the main port relief spool or poppet is useful in the control and elimination of shock. Through this orifice passes a small oil flow which can be used to control the build-up of system pressure and may also be used to control the shifting of other valves in the circuit.

2 **A "hot installation . . .**



All of the oil pumped in this system will bypass to tank at relief valve pressure setting, except when the cylinder is moving at full speed. This results in power waste and the build-up of heat in the system which can only be removed by external coolers. A reservoir of adequate heat exchange capacity to handle the excess heat would be extravagant in size and totally out of proportion with the sizing of the balance of the system. Other advantages of this particular circuit lie in the shock present when the directional valve is shifted to reverse direction of cylinder motion, and the inability to stop the cylinder except at the extreme positions of its travel.

3 **A tandem type spool . . .** The cylinder moves only when the directional valve spool is shifted. When the 4-way valve is in the neutral position, the closed cylinder ports block cylinder movement, and allow the flow from the pump to bypass to tank with little resistance. With this circuit, the pump is allowed to idle except when flow and power are required for cylinder movement.



When this circuit is used with small pump flows, and the directional valve spool has been designed with tapered lands, it is a practical system—simple and efficient. With small flows and adequate sized lines, the shocks encountered will be of minor consequence. When we get into larger flows and higher pressures, i.e., 10 gpm and up, and 500 psi and up, then this circuit becomes a real "shock-generator".

One of the major causes of hydraulic shock is the inertia effect of the mass of the moving oil undergoing an abrupt change in flow path. When the 4-way valve is in neutral, the path of the moving oil is through the tank port back to tank. When the valve is shifted, the oil is directed to one of the cylinder ports. Momentarily, the cylinder and the mass system coupled to it resist motion, and the flow of the oil is stopped. It tends to build-up in pressure instantaneously. Because of the mass of the moving parts in the relief valve and because of a slight lag in its normal function, it does not open fast enough to relieve this instantaneous pressure build-up, and the entire system is subjected to this intense shock momentarily. Shocks of this type are generated by pressure build-up rates of 100,000 to 300,000 psi per second. Of course, if the directional valve spool were shifted very, very slowly and smoothly, the shock could be alleviated considerably and perhaps eliminated entirely. With manual valve operation, a great amount of skill would be required on the part of the operator to achieve this fine degree of control.

4 **Solenoid-controlled pilot-operation . . .** further complicates the circuit because sufficient pressure to pilot the 4-way valve when the pump is unloaded must be maintained. This is accomplished by the introduction of a check valve into the tank line from the 4-way valve to establish a minimum back pressure of 50 to 75 psi.

Even this relatively low back pressure is sufficient to generate a considerable amount of frictional heat when a large pump flow is produced. Moreover, when the solenoids are energized, valve shift takes place rather rapidly—tending to produce violent shock in the pump discharge line. To elimi-

nate this shock, flow control valves of various types are added in an effort to cut down pilot flow to the main spool to slow down shifting speed. This speed control is always quite critical in an attempt to eliminate shock and still not cut down the overall machine cycle rate or response to an undesired extreme. Because the setting of pilot choke devices is so critical, slight changes in oil viscosity due to temperature change, even in the course of one hour of operation, will upset this delicate balance.

5 Applying the vented relief valve . . . In this circuit, principles for the design of heat-free and shock-free high horsepower systems are applied. They are:

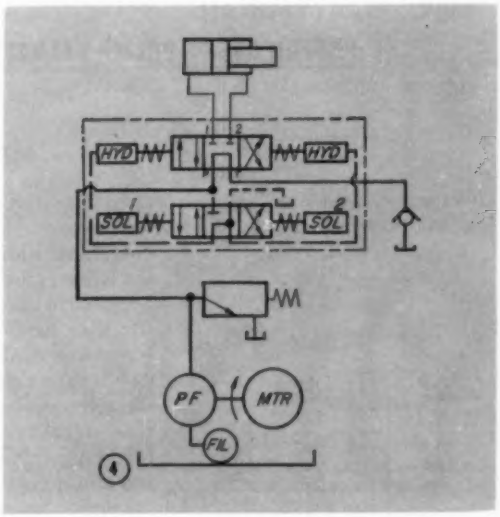
1. Unload the pump through the venting of the main relief valve at all times except when actually needed for actuator movement.
2. Establish the direction of actuator movement first by shifting the directional valve. (This valve shift must take place when the pump is at low pressure)
3. After the directional valve has been shifted completely, build up and apply pressure to the load gradually.
4. Never change direction of actuator movement with pump pressurized.

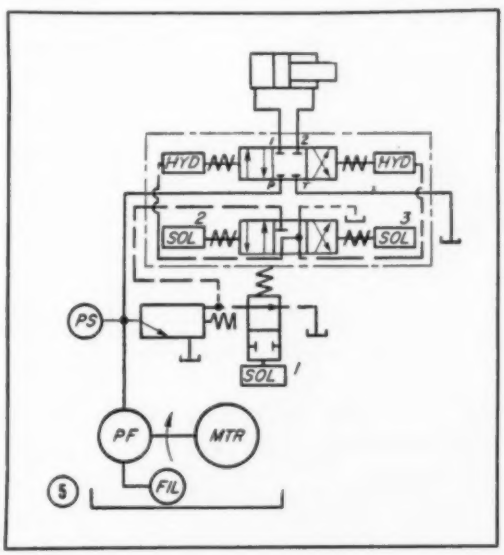
The electrical controls are set up to energize Sol. 1 whenever either of the directional control solenoids (Sol. 2 or Sol. 3) are energized. With all solenoids de-energized, the pump flow is bypassed to tank through the vented relief valve with a back pressure of perhaps 10 to 25 psi. It will be noted that the 4-way valve has an external pilot pressure source and this port is connected to the venting port of the relief valve.

When Sol. 1 and Sol. 2 are energized simultaneously, the pilot oil from the relief valve, which previously was vented directly to the tank through the normally-open 2-way venting valve is now directed to the pilot chamber of the main spool on the 4-way valve. When the system pressure has increased to the pressure necessary to shift the 4-way valve (50 to 75 psi) the directional spool shifts and establishes the direction of motion for the cylinder. While the 4-way valve spool is shifting, the system pressure can be no higher than that required to overcome the resistance of spool shift. It is not until the directional spool has shifted to its extreme position that the system pressure can increase to the pressure required by the work load or to the pressure setting on the relief valve, whichever is the lesser value.

The pressure switch is tied into the electrical control system to prevent directional valve shift until system pressure has dropped to unloading value. Thus, when it is desired to reverse the direction of motion of the cylinder, Sol. 1 and Sol. 2 are de-energized. Sol. 1 and Sol. 3 cannot then be energized until the pressure switch has been reset by the drop in pump pressure.

With proper selection of line and relief valve

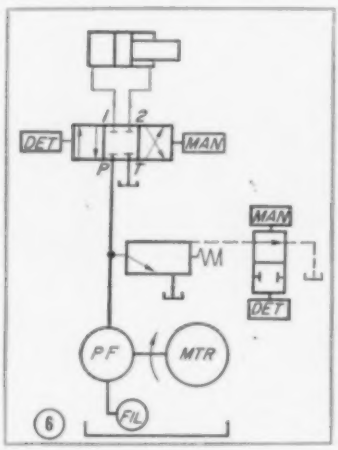




sizing, the heat generated by this system just described will be almost negligible, and another advantage of relief valve unloading will be the elimination of the tendency of the cylinder to creep because of slippage past the directional valve spool.

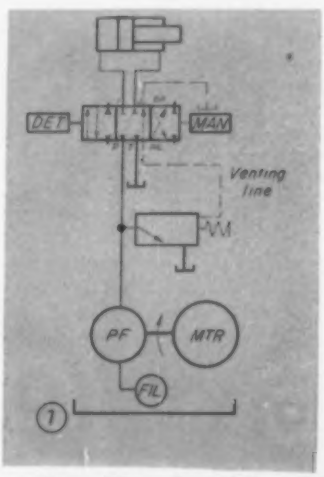
6 Manually-vented systems . . . In this circuit, the pump has been unloaded by the manually-operated 2-way valve, and the 4-way valve is in the neutral position during the idle part of the cycle. The operator first shifts the 4-way valve to establish direction of cylinder motion, and then starts and stops the motion with the venting control on the relief valve. This venting control may take the form of a two-position spool-type two-way valve, or it may take the form of a remote pilot relief valve,

either screw, hand-lever, or cam-operated. The starting and stopping can be even more smoothly controlled with the remote pilot relief valve control than the 2-way valve control because of the extremely fine pressure build-up control afforded by the spring poppets in the remote pilot relief valves.



The disadvantages in this system lie in the slowness of operation and in the degree of skill required on the part of the operator.

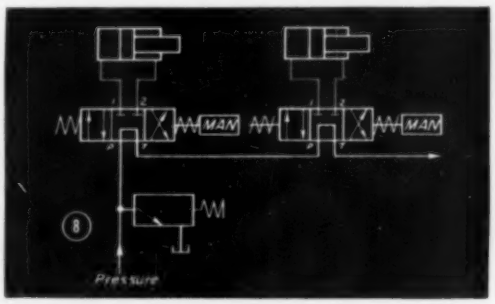
7 Venting and directional control . . .



A 4-way valve with an integral 2-way venting valve operated simultaneously with the main spool is used. This valve offers all of the advantages of circuit 6 with greater operational speed possible and much less skill required on the part of the operator. When the 4-way valve is in neutral position, the relief valve is vented and the pump is unloaded. When the directional valve is shifted to either extreme, the relief valve vent line is blocked and the system pressure is applied very smoothly to the load.

8 Tandem circuit problems . . . The disadvantages of the conventional tandem circuit are:

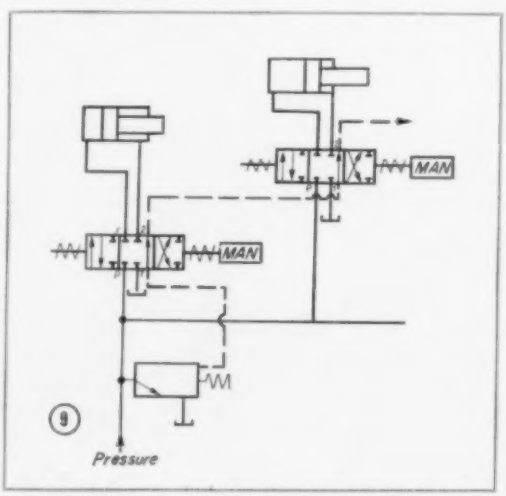
1. All of the directional valves must be sized according to the pump flow, and not according to the requirements of each particular branch of the multiple circuit.
2. With three or more valves in tandem, the pressure drop across the valves and lines is considerable, and true pump unloading is not possible.
3. Only one valve may be actuated at a time.
4. The same shock is prevalent in this type of circuit as in the circuit shown in circuit 3.



9 Multiple cylinder operation . . . All of the advantages of the conventional tandem circuit and none of its disadvantages are obtainable with this circuit. The venting valves built-in to each of the 4-way valves are connected in series with the venting line from the relief valve. When all of the spools are in neutral the pump is unloaded through the vented relief valve. Shifting of any spool from neutral blocks the vent on the relief valve and affords smooth control of that particular cylinder.

Extra advantages of this system are:

1. Since the pump is unloaded through the relief valve, considerably less heat is generated and much less power is wasted in comparison to the tandem circuit.
2. Several valves may be operated simultaneously.



PUMPS

DEVELOP OIL HYDRAULIC POWER

2 to 100 gpm—continuous duty operation up to 1500 psi—up to 1800 rpm—single or double rotation—constant delivery.

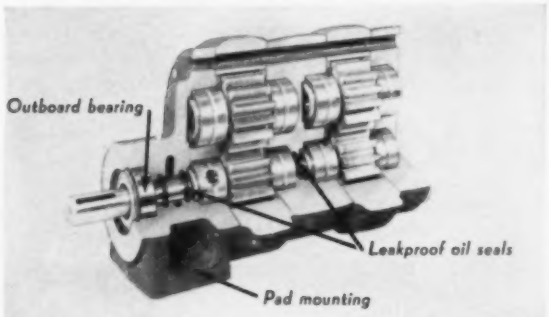


Fig. 1—Two gear pumps assembled in tandem on common shaft deliver independently—can be piped for dual operation or combined for double capacity single operation. "Pressure Pocketing" reduces slippage, friction and wear—volumetric and mechanical efficiency over 90%.

GEAR SIZE	SPEED (R.P.M.)	OUTPUT (G.P.M.) at discharge pressure psi 500	1000	1500	INPUT (H.P.) at discharge pressure psi 500	1000	1500
PC SERIES 1"	600	2.3	1.1	0.5	1.2	2.3	3.5
	1200	4.5	3.6	2.6	2.4	4.5	7.0
	1800	7.2	6.0	5.5	3.8	6.7	10.5
PD SERIES 1"	600	6.6	6.4	6.3	2.6	4.0	7.0
	1200	13.2	13.0	13.0	5.2	8.0	13.5
	1800	19.3	19.0	19.0	7.5	12.0	20.5
PJ SERIES 2"	600	19.4	18.7	18.4	6.2	12.3	18.0
	1200	41.3	40.6	40.0	12.8	24.7	37.4
	1800	62.1	61.0	60.3	20.5	38.6	58.8

Performance data for PC and PD pumps having gear widths other than shown above can be approximated by multiplying values in above table by width of desired gear; for PJ pumps multiply by 1/2 the width of desired gear.

PC SINGLE PUMPS

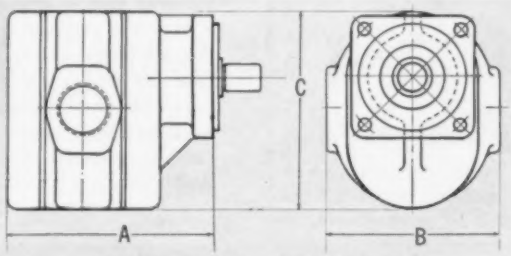
3 gear widths, 1/2", 1", 1-1/2".
4 round shaft sizes.
pedestal and 3 flange mountings.
tapped ports—side or end.

PD SINGLE PUMPS

7 gear widths, 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3"
8 round and 3 splined shaft sizes.
pad and 7 flange mountings.
tapped ports—side or end.

PJ SINGLE PUMPS

5 gear widths, 2", 2-1/2", 3", 3-1/2" and 4".
1 round and 1 splined shaft size.
2 flange mountings.
tapped or split flange side portings.



DIMENSIONAL DATA (Approx.)

	A*	B	C
C SERIES	4" + gw	4"	4 1/2"
D SERIES	5 1/4" + gw	6 1/2"	6 3/4"
J SERIES	7" + gw	8"	9"

*When fitted with socket head cap screws. If fitted with hex head cap screws add thickness of head. gw = gear width

MOTORS

UTILIZE OIL HYDRAULIC POWER

2 to 68 hp—continuous duty operation up to 1500 psi—up to 1500 rpm—single or double rotation—variable speed.

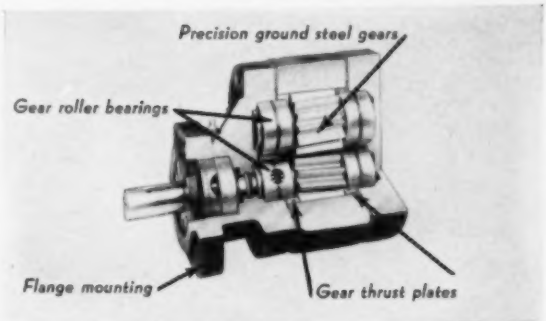


Fig. 2—Single gear motor can be piped from side on end ports. Extra large gear bearings maintain shaft alignment; heavy-duty outboard bearing absorbs drive shaft and shock loadings. New leakproof oil seals maintain internal pressure balance.

GEAR SIZE	SPEED (R.P.M.)	INPUT (G.P.M.) at input pressure psi 600	1000	1500	OUTPUT (H.P.) at input pressure psi 600	1000	1500
MC SERIES 1"	600	4.1	4.7	5.3	0.8	1.4	2.4
	1000	7.1	7.4	7.7	1.3	2.4	3.4
	1500	9.6	10.4	10.8	1.9	3.5	4.5
MD SERIES 1"	600	8.2	8.6	9.0	2.1	3.5	4.3
	1000	12.5	13.6	14.0	3.5	5.8	8.0
	1500	18.0	19.0	20.0	4.3	8.0	11.2
MJ SERIES 2"	600	21.3	21.8	23.3	5.7	10.2	15.5
	1000	34.2	35.4	36.9	8.7	15.8	24.9
	1500	54.0	55.0	57.5	10.2	21.5	34.3

Performance data for MC and MD motors having gear widths other than shown above can be approximated by multiplying values in above table by width of desired gear; for MJ motors multiply by 1/2 the width of desired gear.

MC SINGLE MOTORS

3 gear widths, 1/2", 1", 1-1/2".
4 round shaft sizes.
pedestal and 3 flange mountings.
tapped ports—side or end.

MD SINGLE MOTORS

7 gear widths, 1/2", 3/4", 1", 1-1/2", 2", 2-1/2", 3".
8 round and 3 splined shaft sizes.
pad and 7 flange mountings.
tapped ports—side or end.

MJ SINGLE MOTORS

5 gear widths, 2", 2-1/2", 3", 3-1/2" and 4".
1 round and 1 splined shaft size.
2 flange mountings.
tapped or split flange side portings.

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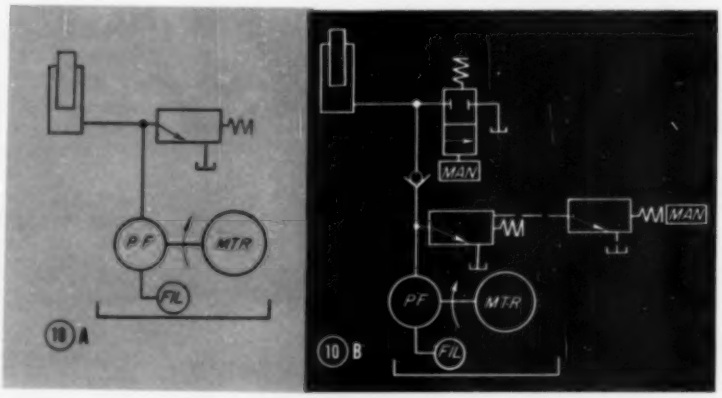
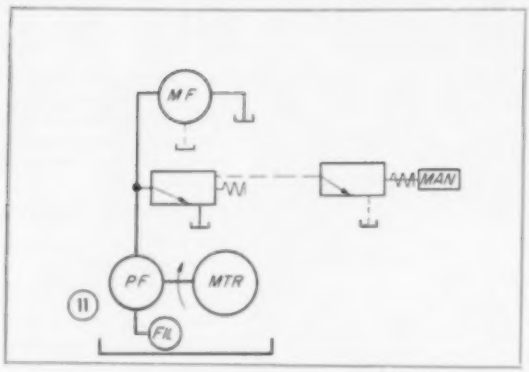
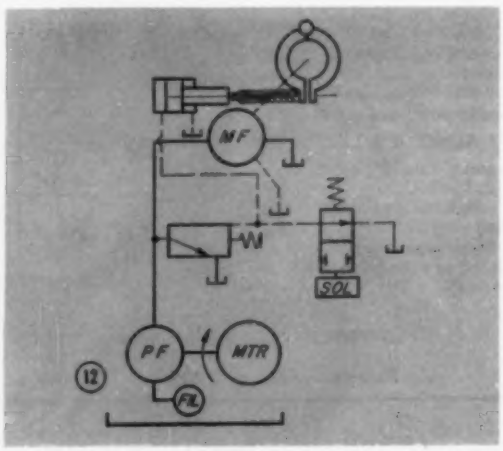
10 Single-acting cylinders . . . The relief valve may be used by itself to control the action of a simple single-acting ram. The ram would be returned by gravity or by a spring. The pressure may be controlled directly by the adjusting knob on the relief valve or it may be controlled remotely by a pilot relief valve—either screw or lever-operated. With the screw backed out to its extreme position, the pump is unloaded and the ram is down. The pressure is increased to raise the load. When the pressure is increased to the point where it balances the load and friction forces, the ram will stand stationary. A slight increase in pressure will cause the ram to move upward with the load, and a decrease in pressure will allow the ram to return. When it is desired to hold the single-acting ram and load elevated and stationary for any length of time, and when holding the load with pump pressure will produce a considerable amount of heat, a check valve is introduced as in Figure 11. This check valve holds the load elevated while the pump is unloaded, until the manual bypass valve is opened to lower the ram. For smooth lowering this manual bypass valve should take the form of a needle valve.





11 Fluid motor control . . . This is the simplest form of on off control for fluid motor. By blocking the vent on the relief valve, the operating pressure increases to accelerate the load smoothly. When the vent port is opened to tank, the motor coasts to a stop. It is assumed that the unloading pressure, when the relief valve is vented, will be low enough to eliminate any tendency for the fluid motor to creep. Solenoid control of venting could be used in this circuit with excellent results. By utilizing a relief valve with built-in solenoid venting 2-way valve, the piping is simplified.

12 Addition of brake . . . The automatic parking brake is spring set and hydraulically released by the build-up of pressure in the relief valve venting line when the fluid is de-energized, the pump is unloaded. The fluid motor is depressurized, and stops with the setting of the brake by the elimination or dropping of venting pressure.



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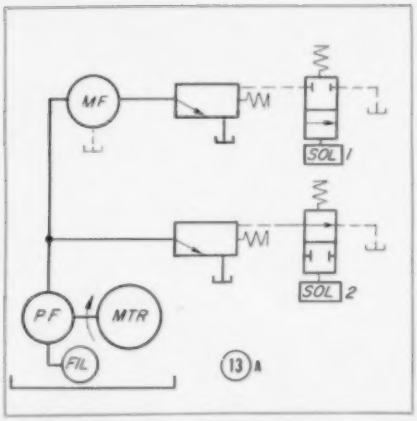
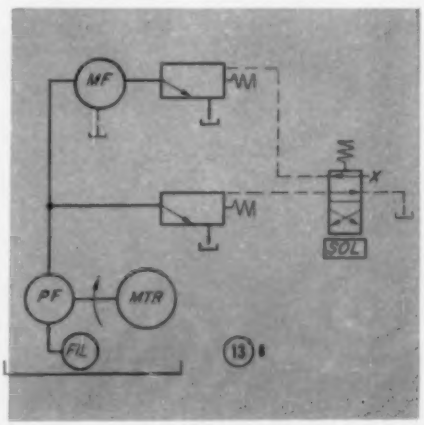
PROPER USE OF RELIEF VALVES

13 Dynamic braking . . . can be introduced to a circuit by the use of a normally-closed solenoid vented relief valve. Circuit A utilizes two solenoid-vented relief valves—one normally open for acceleration control and one normally closed for deceleration or braking control. When both solenoids are energized the motor starts to rotate with a very smooth acceleration and application to the load. When both solenoids are de-energized, the pump is unloaded and the back pressure imposed on the discharge line from the fluid motor brings it to a gradual stop. The magnitude of deceleration and acceleration can be pre-set and predetermined by the pressure settings on the two relief valves. Circuit B uses the same principles as the previous circuit but vents two basic relief valves through a solenoid-controlled 4-way pilot valve.

Directional control may be added for fluid motor circuits by the use of a 4-way valve to reverse direction of oil flow through the fluid motor. When the braking relief valve is used it should be in series with the tank line from the 4-way valve. The principles illustrated in Figure 5 should be applied to fluid motor control, particularly for hi-speed, high-inertia drives. For smooth starts and reversals:

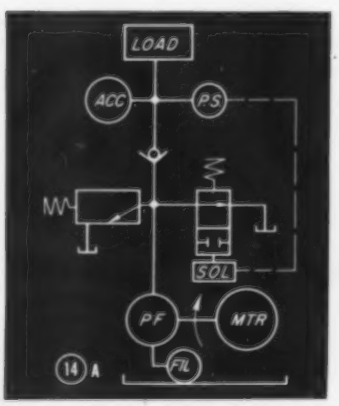
1. Shift 4-way valve first,
2. Open braking valve and build up accelerating pressure gradually.
3. Reduce pumping pressure and apply braking pressure to stop load; do not shift 4-way valve back to neutral until load and motor is stopped or near zero speed.
4. Use relief valve venting oil for piloting directional valve to eliminate shock and to achieve velvety smooth control.

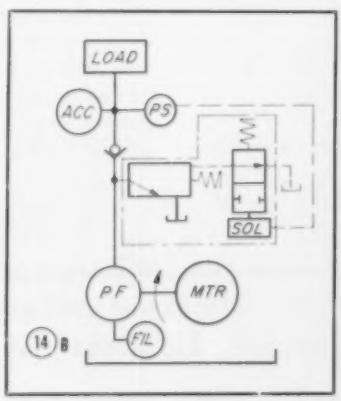


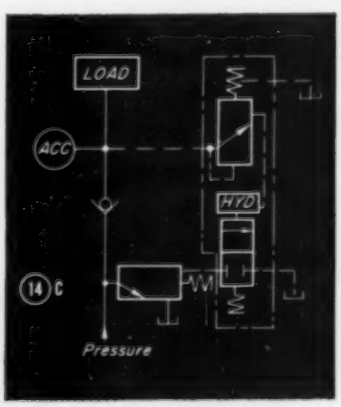


14 Accumulator circuits . . . Circuit A shows a typical accumulator-pump circuit in which a pressure switch is actuated by the rise in pressure of the oil in the accumulator and deenergizes the 2-way solenoid-controlled unloading valve. The same unloading function can be performed more smoothly, with less abrupt change of oil flow direction, and less expensively by the use of the solenoid-controlled venting valve as shown in circuit B.

When electrical solenoid operation is undesirable or impossible, hydraulically-vented relief valves can be used as suggested in circuit C. In this circuit, a pressure pilot line leads to a relay or sequence type unloading pilot valve. When the accumulator pressure exceeds the setting on the unloading valve, pilot pressure holds open the 2-way venting valve. This venting valve allows the relief valve to unload the pump to tank. When accumulator pressure drops, then the venting valve closes and the pump recharges the accumulator.







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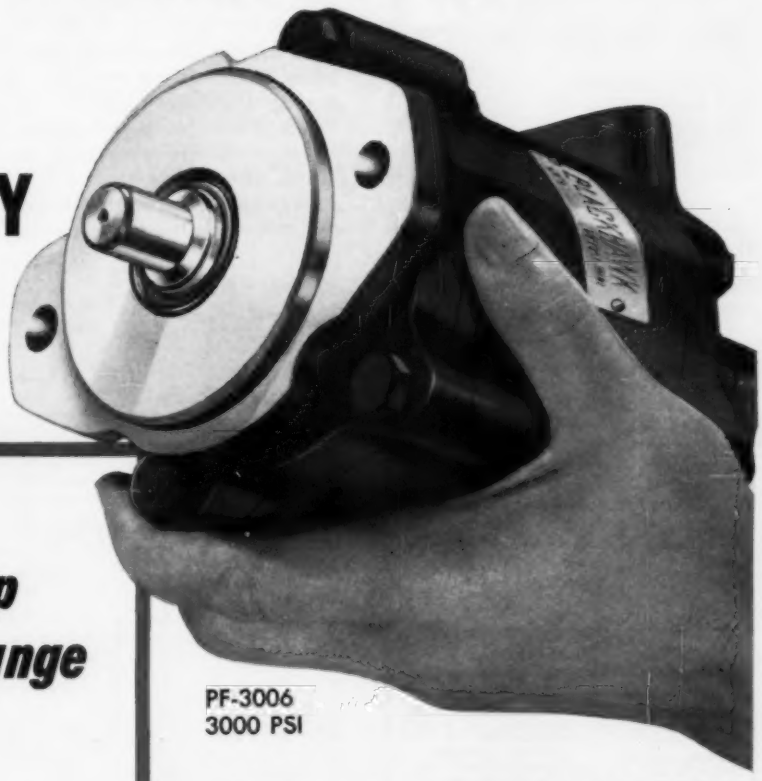

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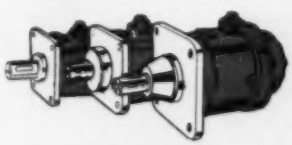

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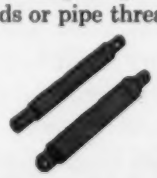

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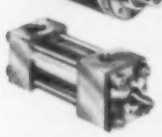

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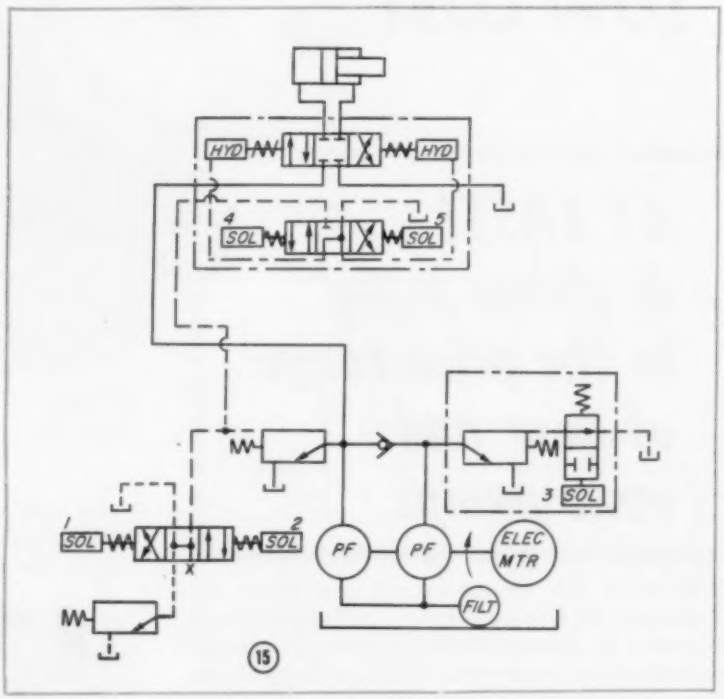
PROPER USE OF RELIEF VALVES

15 Multiple pump control . . . In the design of hydraulic circuits, the size of the pump should be matched to the size of the job to be done. In a great many cases, pump is selected on the basis of the greatest branch circuit demand. When functional requirements of various portions of the circuit vary greatly, there will be a build-up of excess heat during the time when the slower-moving functions are taking place.

Circuit 15 shows how various operating flows and maximum operating pressures may be selected electrically to give optimum circuit efficiency. In this case, the use of the pilot-operated relief valve with positive displacement pumps yield many of the benefits normally attributed to variable delivery pumps with pressure compensator controls.



In the various circuits presented, the shock under discussion has been that generated in the pump discharge line and caused by the abrupt change of oil flow path. In some circuits, hydraulic shock may be generated in the cylinder lines by the fast centering of a closed-center 4-way valve. Where speeds and inertia loads are moderate, this shock condition may be alleviated by suitable spool land tapering to give more desirable deceleration effects. Where speeds and inertia loading are high, some form of dynamic hydraulic deceleration as shown in 13A and 13B should be designed into the control circuit. ▼▼▼

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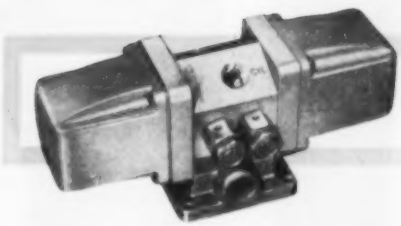

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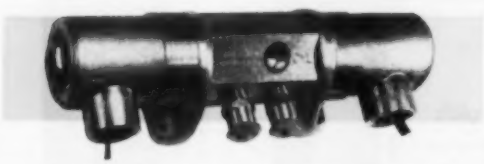

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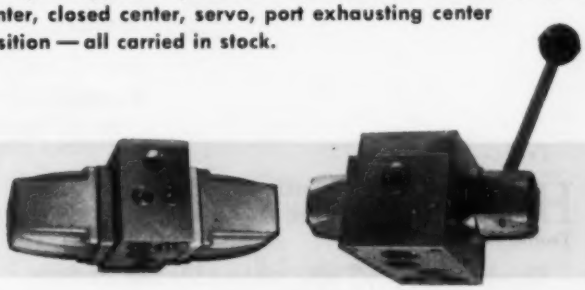

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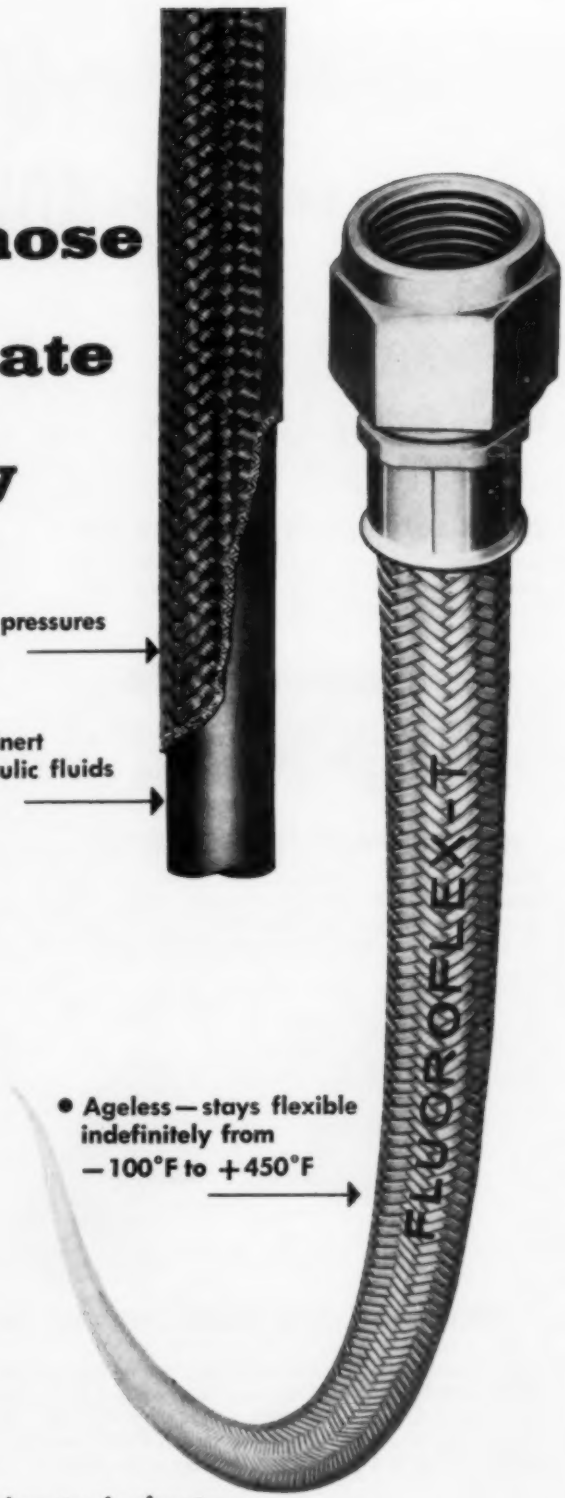

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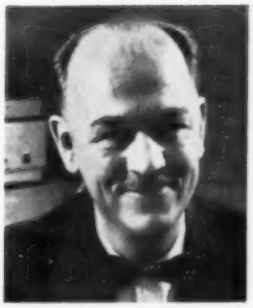

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Director

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12th National Conference Industrial Hydraulics

DISCUSSION of hydraulic applications in the nuclear field by three atomic energy specialists is one of the outstanding features of this year's conference.

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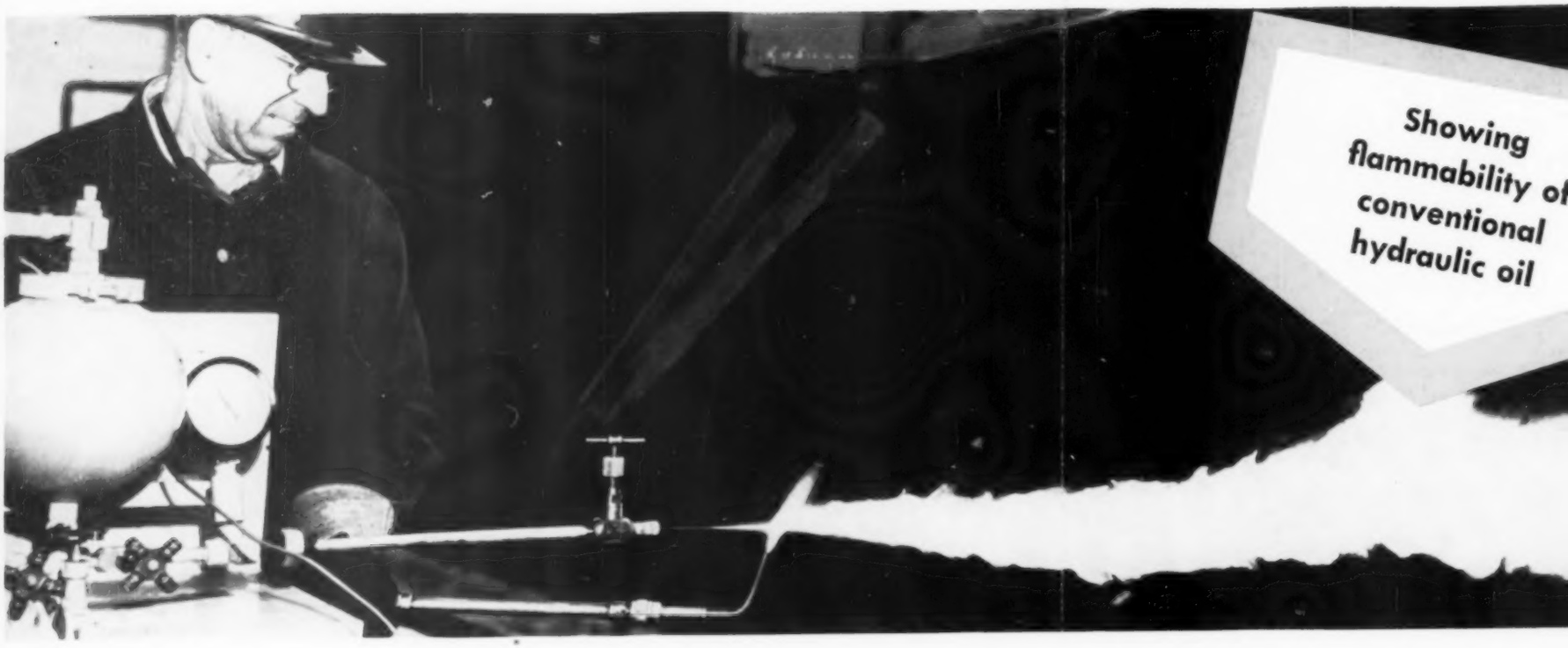

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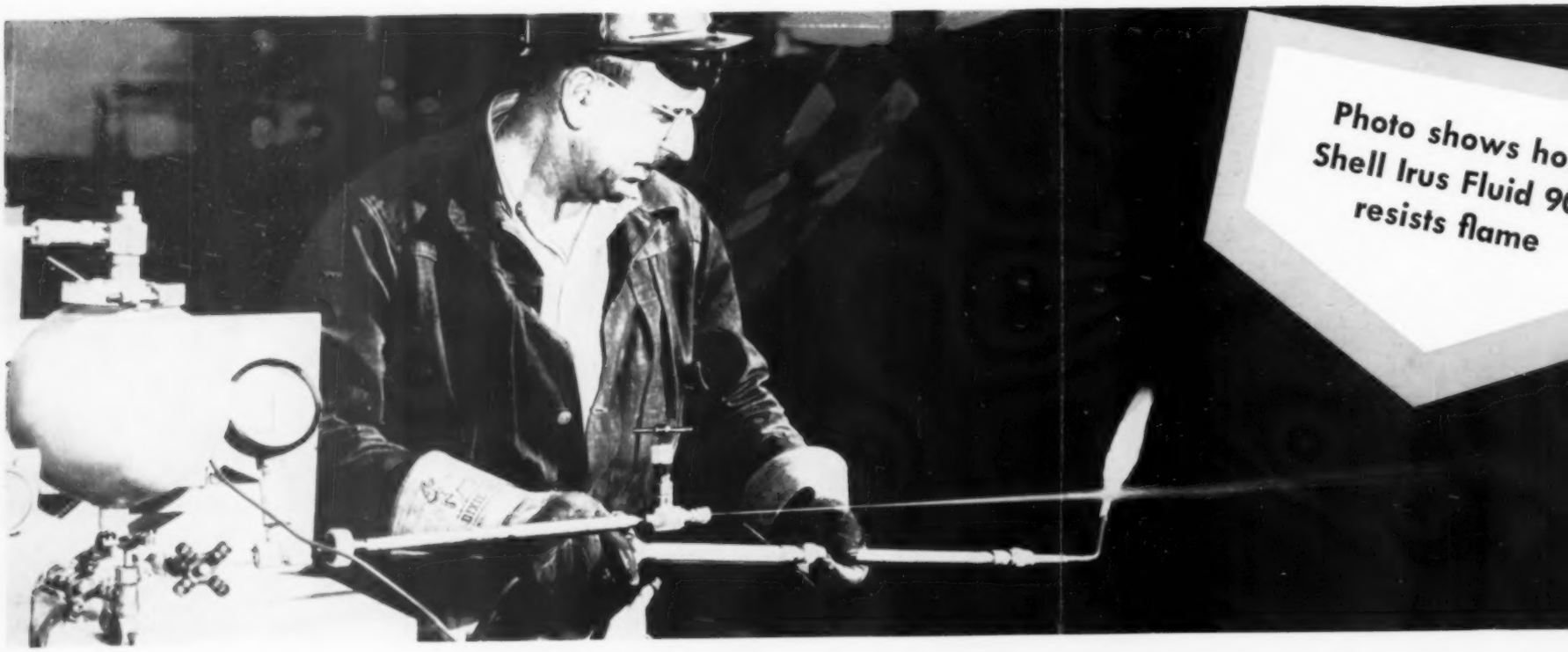

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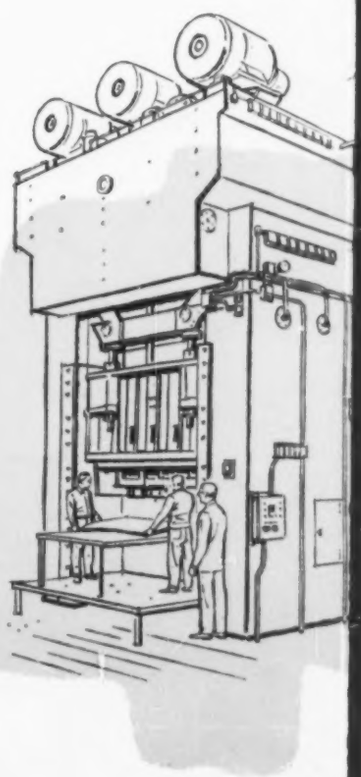

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P R O G

OF THE NATIONAL CONFERENCE ON INDUSTRIAL

THURSDAY, OCTOBER 18, 1956

8:30 A.M. Registration: Sherman Hotel, Chicago

9:00 A.M. GENERAL SESSION

Chairman: J. C. Boyce, Vice President, Illinois Institute of Technology. "Hydraulic Applications in Atomic Energy"

1) "Reactor Principles and Types", Richard F. Humphreys, Assistant Director, Armour Research Foundation.
2) "The Consolidated Edison Reactor (New York)", Frank R. Ward, Assistant Director, Atomic Energy Division, Babcock and Wilcox Company.
3) "Reactors of the Future", Stuart McClain, Program Coordinator, Argonne National Laboratory.

12:15 P.M. LUNCHEON SESSION

Speaker: Bruce L. Smyth, Assistant Vice President, Federal Reserve Bank of Chicago. "Principles of a Good System".

Presentation of awards to winners of APPLIED HYDRAULICS 1956 PRIZE PAPER CONTEST.

2:00 P.M. AFTERNOON TECHNICAL SESSIONS

Pumps

Chairman: John A. Lauck, Vice President and Director of Engineering, Pesco Products Division, Borg-Warner Corporation.

1) "Higher Speeds and Pressures for the Hydraulic Pump", Ernest H. Schanzlin, Chief Engineer, Hydraulic and Air Division, Pesco Products, Borg-Warner Corporation.
2) "A Comparison of Open and Closed-Center Type Hydraulic Systems", Robert B. Banks, Associate Professor of Civil and Science Engineering, Northwestern Technological Institute.

Components and Accessories

Chairman: James O. Heyworth, Vice President, Industrial and Aircraft Division, Barco Manufacturing Company.

1) "Teflon—Use of Teflon Packing and Seals in Hydraulic Applications", E. C. Bertolet, Jr., Assistant Chief Engineer, United States Gasket Company
2) "Hydraulic Filters in Fluid Power Installations", O. E. Teichmann, Central Research Laboratory, Borg-Warner Corporation, and E. G. Fochtman, Armour Research Foundation.

Pneumatics

Chairman: Joseph J. Slomer, Hydraulic Engineer, Goodman Manufacturing Company.

1) "Design Factors Involved in a High Pressure Air Coal Blasting Method", Richard J. Bailey, Project Manager, High-Pressure Air, Cardox Corporation.
2) "Method of Calculation and Measurement of Pressure Drop in Pneumatic Components", M. M. Slawsky, Pneumatics Laboratory, National Bureau of Standards.

Servomechanisms and Systems Analysis

Chairman: Ralph J. King, Staff Engineer, Caterpillar Tractor Company.

1) "The Hydraulic Servomotor and its Place in the Age of Automation", Murray Kanes, Supervisor of Automation, Bendix Research Laboratories.
2) "The Hydraulic Servomotor—Problems in Design and Operation", Gerhard Reethof, Chief, Research Section, and LeRoy D. Taylor, Assistant Chief Development Engineer, Vickers, Incorporated.
3) "Systems Analysis and the Hydraulic Servomotor", William W. Seifert, Director, Dynamic Analysis and Control Laboratory, Massachusetts Institute of Technology.

6:30 P.M. ALL ENGINEERS' BANQUET

Speaker: George Emerson Davis, Director, Division of Adult Education, Purdue University. "A Hoosier Humorist"

FRIDAY, OCTOBER 19, 1956

9:00 A.M. MORNING TECHNICAL SESSIONS

Mobile Equipment

Chairman: Joseph F. Ziskal, Assistant Division Chief Engineer, Advanced Engineering Department, International Harvester Company.

1) "Power Steering for Off the Highway Vehicles", Ralph M. Lehman, Assistant Sales Manager, Ross Gear and Tool Company, Inc.

Automatic Machine Tools

Chairman: Ernest J. Svenson, President, John S. Barnes Corporation.

1) "Hydraulic Control of Automatic Mass Production Tools", a moving picture and discussion by Ernest J. Svenson, A. B. Riddiford, Jr., and others from John S. Barnes Corporation.

Aircraft Systems

Chairman: John T. Marshall, Chief Engineer, Hamilton Division, Bendix Aviation Corporation.

1) "Vapor-Liquid Ratio Meters for Aircraft", Richard K. Stoms, Project Engineer, Cincinnati

G R A M

RIAL HYDRAULICS • 1956 •

Division, Bendix Aviation Corporation.

2) "High Temperature Hydraulics in Airborne Equipment", Duncan B. Gardiner, Director of Research and Development, and Frank L. Moncher, Chief Engineer, Airborne Products, Vickers, Incorporated.

12:15 P.M. LUNCHEON SESSION

Speaker: Dan T. Moore, Industrial Consultant, formerly with United States Counter Intelligence in the Middle East. "The Middle East—Boiling Pot of the World"

2:00 P.M. AFTERNOON TECHNICAL SESSIONS

Hydraulic Fluids

Chairman: Robert Q. Sharpe, Staff Engineer, Lubricating Department, Socony Mobil Oil Company, Inc.

1) "Do You Need Fire Resistant Hydraulic Fluids in Your Plant?", George M. Woods, Special Engineer, Factory Insurance Association.
2) "Fire Hazard Evaluation of Hydraulic Fluids", A. F. Matson, Managing Engineer, Chemical Department, Underwriters' Laboratories, Inc.
3) "ASTM Looks at Fire Resistant Hydraulic Fluids", William H. Millett, Sales Manager, Ucon Products, Carbide and Chemicals Company.

Presses

Chairman: Melvin G. Sulzer, Regional Manager, Denison Engineering Company.

1) "Design and Circuits of Small Hydraulic Presses", Robert H. Krepps, General Sales Manager, and Carl W. Lindhal, Executive Assistant to Director of Engineering, Denison Engineering Company.
2) "Component Comparison for Electro-Hydro Servo," George M. Moore, Jr., Senior Engineer, Raytheon Mfg. Co.

Automotive

Chairman: F. L. Mackin, Chairman, Machine and Wood Shops and Hydraulics, General Motors Institute.

1) "Development of a Hydraulic Starter for Cranking Diesel Engines", John H. Smith, Section Head, Hydrostarter Engineering, Aeroproducts Operations, Allied Division, General Motors Corporation.
2) Torque Converters for Commercial Application", R. M. Tuck, Development Engineer, Transmission Engineering Division, Allison Division, General Motors Corporation.

John Lauck
Chairman
Pumps

J. O. Heyworth
Chairman
Components-Accessories

J. J. Slomer
Chairman
Pneumatics

Ralph J. King
Chairman
Servomechanisms

J. F. Ziskal
Chairman
Mobile

J. T. Marshall
Chairman
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Lecturers at the NCIH have written these abstracts to give the gist of each paper. Complete papers will be published in a bound volume early in 1957.

Summaries of

TECHNICAL PAPERS

presented at 12th NCIH

● REACTOR PRINCIPLES AND TYPES

by R. F. Humphreys, Assistant Director, Armour Research Foundation

There are six major components essential to the design and operation of any reactor, regardless of its ultimate use. These are discussed, along with the many problems involved in optimizing these components for a reactor designed to produce power. These difficulties include lack of experience, inadequate materials, component designs, and uncertain economic factors. A generalized presentation of reactor types is given, with a discussion of their relative advantages and disadvantages.

● THE CONSOLIDATED EDISON REACTOR

by Frank R. Ward, Assistant Director, Atomic Energy Division, Babcock and Wilcox Company

This reactor is now being designed and developed by the Babcock & Wilcox Company. It will be a pressurized water, converter type, and will be the first commercial unit to use thorium as the fertile material, supplementing the base fuel uranium 235. The reactor will generate 500,000 kilowatts of heat to produce 140,000 kilowatts of electric energy. Saturated steam leaving the reactor will be superheated in a separate oil fired unit, increasing the total capacity to 236,000 kilowatts. The reactor system and its component parts are described and those features of the remainder of the plant are covered which are important to reactor operation. The reactor will be located on the Hudson River near New York City, and project schedules and estimated construction and operating costs are also discussed.

● REACTORS OF THE FUTURE

by Stuart McClain, Program Coordinator, Argonne National Laboratory

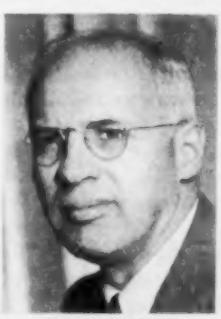
The requirements for nuclear power in the United States and abroad are reviewed. This is followed by an outline of the estimated growth of the nuclear power industry. There is a brief discussion of the economics of the industry, and some of the major problems, such as reactor safety, power plant location and utilization, fuel supplies, and disposal of wastes.

● HIGHER SPEEDS AND PRESSURES FOR THE HYDRAULIC PUMP

by Ernest H. Schanzlin, Chief Engineer, Hydraulic and Air Division, Pesco Products, Borg-Warner Corporation.

The trend toward higher horsepower and higher speed engines has reflected itself in an ever grow-

R. F. Humphreys



Stuart McClain

Frank R. Ward

ing demand for higher pressures and operating speeds for hydraulic pumps. Generally, in the earth moving equipment and lift truck field, current operating pressures are in the neighborhood of 1500-2000 psi, and are gradually going upward. The higher speed and higher pressure pump offers many economic advantages for the overall hydraulic system, but also imposes design and installation problems.

Robert B. Banks

Ernest H. Schanzlin

Development work on a pressure loaded type of gear pump has shown bearings and gear finishes are the principle problem. Installation is also important, as reservoir design and inlet conditions are a big factor in determining the reliability of these units. Other problems discussed include housing strength, packings and general design.

In addition, a detailed discussion is given on a low cost, 3000 psi, 3200 rpm gear pump, incorporating the use of die castings.

● A COMPARISON OF OPEN AND CLOSED-CENTER TYPE HYDRAULIC SYSTEMS

by Robert B. Banks, Associate Professor of Civil Engineering and Science-Engineering, Northwestern Technological Institute.

In designing a hydraulic system for a particular application, the designer must decide whether the system is to be an open or closed-center type. This paper covers the various factors the designer considers in making this decision.

Open and closed-center hydraulic systems are defined so that comparative advantages and disadvantages of the two systems could be clearly illustrated. Detailed consideration is given to the many aspects pertinent to the selection of the type of system. The discussion covers the relationship between the type of pump and type of system, feasibility of periodic pump operation, use of pressure relief valves, excessive wear of pump, waste of power, and oil overheating.

Means for unloading the pump discharge pressure are considered with regard to the two types of centers. Circuit components required by the alternative methods to accomplish the overall function of a simple system are tabulated. Aspects of maintaining a "live" system by the alternative types of centers are considered and questions concerned with transient pressures, leakage and fatigue are presented.

● USE OF TEFLON PACKINGS AND SEALS IN HYDRAULIC APPLICATIONS

by E. C. Bertolet, Jr., Assistant Chief Engineer, United States Gasket Company

This is a resume of the basic properties of Teflon, indicating this organic polymer should have excellent possibilities in the hydraulic field. Many phases of hydraulics have been approached with fluorocarbon materials with varying degrees of success.

The discussion covers products which have been used in place of conventional packing and gasket shapes, engineered to utilize the desirable properties of fluorocarbon materials in vital locations. It is stated that superior performance is obtained at costs comparable to conventional materials. Illustrations are presented to show the basic properties of the material, cross-sections of configurations

E. C. Bertolet, Jr.

utilized, and actual applications in finished products.

It is pointed out that the fluorocarbon field is in its infancy. Expansion will take place rapidly as new conceptions are engineered and the materials now in use prove inadequate for new service conditions.

● HYDRAULIC FILTERS IN FLUID POWER INSTALLATIONS

by E. G. Fochtman, Armour Research Foundation, and O. E. Teichmann, Central Research Laboratory, Borg-Warner Corporation

This is a general discussion of the problem of contaminants in hydraulic fluids and the necessity for filtration. Nature and particle size distribution of contaminants is discussed, and their effect on the performance of seals, bearings, control

INTER-OFFICE

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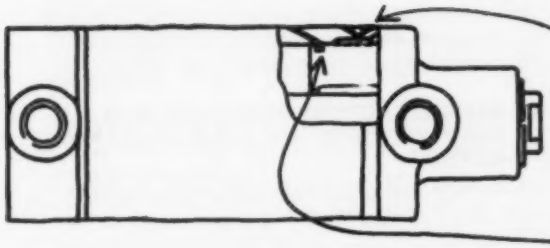

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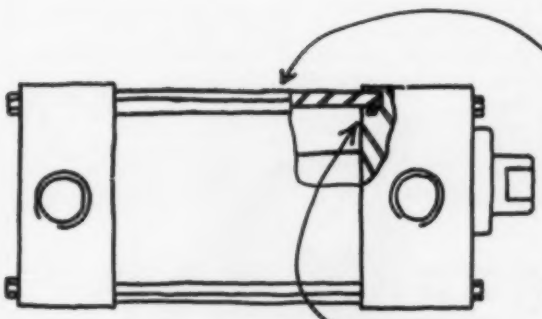

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SUMMARIES OF NCIH PAPERS

valves, and electric relays.

Various types of filters are covered, including strainers, matted or felt filtering elements, porous plugs and filter beds. Performance characteristics are discussed as to cleaning efficiency, capacity, clogging and pressure drop.

Full flow and partial flow systems are covered, and there is a section on special problems. These special filtration problems include the use of Fuller's Earth and oil additives, magnetic filters for removing metal debris, and synthetic fluids.

• *DESIGN FACTORS INVOLVED IN A HIGH PRESSURE AIR COAL BLASTING METHOD*

by Richard J. Bailey, Project Manager, High Pressure Air, Cardox Corporation.

This paper covers the history, description, design and thermodynamic considerations of a method for dislodging coal by the use of high pressure air in place of explosives. The method described is being used in about 20% of the industry today.

Evolution of this method is covered, and some of the considerations which favored its development. A description of the compressors, distribution system and controls is given, to simplify the discussion of the design of the actual discharge assembly.

Richard J. Bailey

Mechanical design features of two types of discharge assemblies are described. Then, one of the designs is studied from both the theoretical and experimental thermodynamic considerations involved in filling and discharge of the assembly. The discussion of the filling process should be interesting as actual fill temperatures are shown to be in close conformity with theoretical calculations on the heat of recompression.

In the conclusion there is a general discussion of possible applications for such a device in other industries.

• *DEFINITION AND MEASUREMENT OF FLOW CAPACITIES OF PNEUMATIC COMPONENTS AND SYSTEMS*

by Milton M. Slawsky, Pneumatics Laboratory, National Bureau of Standards

The general problem of specifying and measuring

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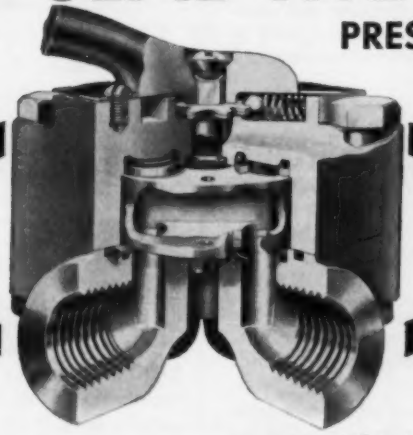

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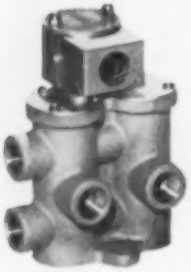

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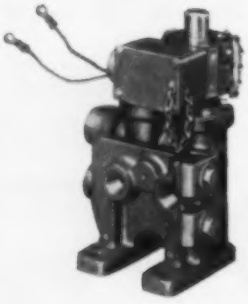

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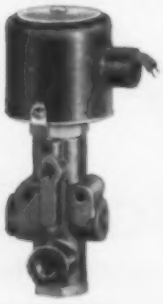

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SUMMARIES OF NCIH PAPERS

the pressure drop in pneumatic components is discussed in this paper. As a part of the discussion, a method for estimating the pressure drop in a single component, or in a series of components, is presented. In addition, a description is given of the method used by the Bureau of Standards Pneumatics Laboratory for rating the flow capacity of pneumatic components.

• PRACTICAL APPLICATION OF HYDRAULIC SERVO MOTOR

by Murray Kanes, Head, Electro-Mechanical Department, Bendix Aviation Corporation, Research Laboratories Division

Various types of servo systems are outlined to illustrate the performance features associated with the hydraulic servo motor. The systems considered include the variable speed transmission and servo valve control hydraulic motor.

A discussion is presented of the performance specifications which must be considered in selecting

Murray Kanes

the servo motor for a given application. The effect of component design on overall system performance is described. The success of any application will thus be governed by proper selection of the servo motor, as well as proper integration with other system components.

Examples of several applications are used to illustrate the effects of servo motor performance and other system design factors upon overall performance. Practical applications range from the high speed missile control system to the control of a variety of machine tools. It is shown that the high performance servo motor is potentially as significant in an industrial application as in the missile field.

• DESIGN AND OPERATION OF HYDRAULIC SERVOMECHANISM COMPONENTS

by Gerhard Reethof, Chief, Research Section, and LeRoy D. Taylor, Assistant Chief Development Engineer, Vickers, Inc.

Hydraulic servo components are now used in a large variety of feedback control applications. Examples of these are machine tools, process con-

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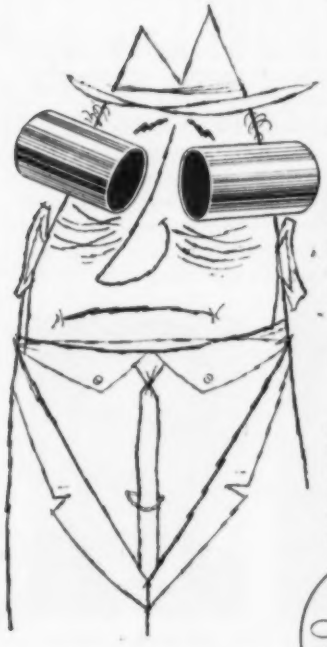

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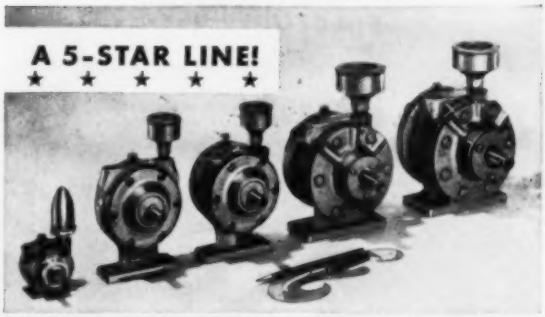

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6. Reversible rotation optional on Models 4AM and 8AM.
7. Very compact—light in weight.
8. Top-quality ball-bearing design.

Write for Bulletins—specify models!

Gast Manufacturing Corp., P.O. Box 117-D, Benton Harbor, Mich.

PERFORMANCE TABLE

Model No.	R.P.M.	HORSE POWER at 60 P.S.I.	HORSE POWER at 90 P.S.I.	Wt. Lbs.
1 AM	2,000 5,000	0.11 0.21	0.13 0.30	1½
2 AM	1,000 2,000	0.22 0.40	0.35 0.57	5¼
4 AM	1,000 2,000	0.48 0.78	0.73 1.10	7½
6 AM	500 2,000	0.40 1.30	0.65 2.00	18
8 AM	500 1,500	1.00 2.30	1.45 3.80	25

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY
- AIR MOTORS TO 4 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

See Our Catalog in Sweet's Product Design File

MODERN HYDRAULICS

demand

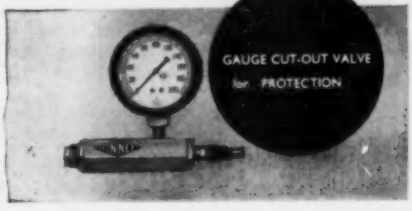
MODERN ANCILLARIES

Greer-Mercier Accumulators, offering power intensification, pressure storage, shock absorption, volume compensation, and surge elimination, are available in a variety of sizes to suit any modern hydraulic application.

FAWCETT FINNEY LIMITED

Finney Sensitive Pressure Switches provide a pressure range of 400—4,000 P.S.I. with pressure differential adjustable between 100—500P.S.I. For wide differentials two micro-switches are fitted.

This Cut-Out Valve automatically isolates recording instruments from pressure surges and offers complete protection within its pressure range of 50 to 4,000 P.S.I.



FAWCETT-FINNEY LIMITED

BERKLEY STREET BIRMINGHAM 1

Telephone: MIDLAND 3795 (3 lines) Cables: FINHYD BIRMINGHAM

A METAL INDUSTRIES GROUP COMPANY

A NEW FABRIC-REINFORCED MATERIAL FOR THESE BACKUP RINGS

MAKE THE GREAT

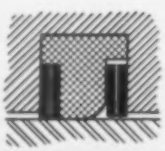
PALMETTO G-T® RING GREATER!

PALMETTO G-T Rings are now available with remarkable "Sealsaver" backups—a development that does a *perfect* job of preventing the T-ring from extruding. These unique guards for the T-ring are cut from an exclusive fabric-reinforced sheet material developed and produced by Greene, Tweed. Even though they are relatively soft and flexible G-T Ring Sealsavers possess a tensile strength of 10,000 psi in *both* directions. They will not craze or fracture during installation *or* in service—enable the PALMETTO G-T Ring to withstand pressures higher than ever.

THE GIST OF THE G-T RING

CANNOT SPIRAL...

The Palmetto G-T Ring, unlike an "O"-Ring, will not twist and turn in the groove. The "T"-form prevents spiral failure in dynamic applications.



CANNOT EXTRUDE...

Resilient "T"-section supported by "Sealsaver" non-extrusion rings on either side makes extrusion impossible. As pressure is applied "Sealsaver" rings are urged against wall, blocking path of extrusion.

In designing for less costly, just as effective substitutes for Vee, Cup and Flange packings, many design engineers have discovered the many benefits PALMETTO G-T Rings offer. Now, with the "Sealsaver" innovation PALMETTO G-T Rings as a dynamic pressure seal for rod or piston applications cannot be matched for economy or effectiveness! Write for more particulars.

PALMETTO Packings

packing more performance into every application

GREENE, TWEED & CO. North Wales, Pa.

Circle 57 on Reader Service Card

SUMMARIES OF NCIH PAPERS

trols, tractor implement actuation, aircraft and missile control surfaces, gun turrets, radar drives. Many types of components are now available for these various applications, and a review is given of several designs and their operating characteristics.

The manufacturing of valves and other components for hydraulic servo systems presents unique problems. Some of the techniques now being used are discussed, as well as the manufacturing requirements for the various types of components.

Gerhard Reethof

Leroy D. Taylor

Quality of manufacturing affects operating problems of hydraulic servo components, directly and indirectly, in many ways. Among the operating problems discussed are friction, wear, differential expansion due to pressure and temperature, dirt and corrosion. The effect of each of these problems on the operating characteristics is described.

• ANALYSIS OF HYDRAULIC SERVO SYSTEMS

by William W. Seifert, Assistant Director, Dynamic Analysis and Control Laboratory, Massachusetts Institute of Technology

Requirements of early hydraulic servosystems were met successfully by designs based on good engineering judgment, using relatively simple analytic techniques, applicable only to a linearized representation of the system. As the use of hydraulic servosystems increased, performance demands also increased, and linearized system models no longer provided an adequate basis for design.

William W. Seifert

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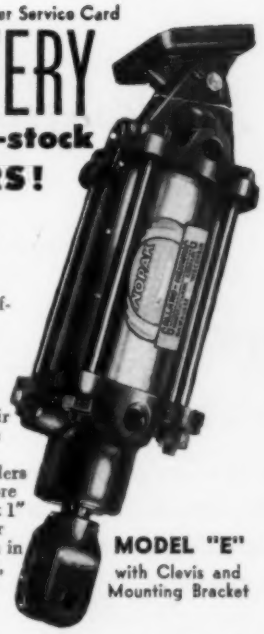
FAST DELIVERY

on NOPAK shelf-stock AIR CYLINDERS!



Your choice of—

- 6 Mounting Styles
- 8 Bore Sizes
- 9 Stroke Lengths

When you specify NOPAK "Shelf-Stock" Air Cylinders you save money 3 ways:

1. You eliminate waiting for "specials".
2. You reduce engineering costs.
3. You get top quality NOPAK Air Cylinders at the lowest possible prices.

NOPAK "Shelf-Stock" Air Cylinders are available in a wide range of bore sizes and stroke lengths from 1½"x 1" to 8" x 15". No other manufacturer offers such a wide range of selection in Brass Tubing, Precision Machined, Cushioned Air Cylinders at comparable prices.

MODEL "E" with Clevis and Mounting Bracket

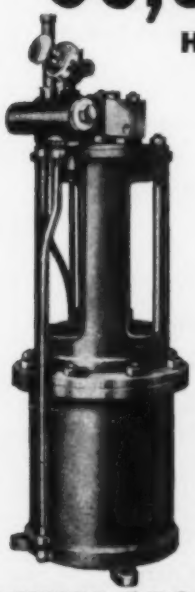
NOW! 5" BORE replaces the 4½" bore in the NOPAK Shelf-Stock line, with no price change — extra cylinder power at no extra cost. Compare quality and prices, and you'll specify NOPAK. Write for Current Listings and Catalog 101.

GALLAND-HENNING NOPAK DIV. • 2743 S. 31st St., Milwaukee 46, Wis.

NOPAK *VALVES and CYLINDERS*

AIR-HYDRO-PUMP

60,000 PSI



HYDRAULIC PRESSURE

(with air-100 psi)

COMPLETE RANGE OF 35 STANDARD MODELS,

SINGLE OR DOUBLE ACTING

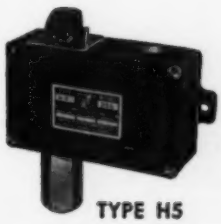
- Air-Hydro-Pump is the finest pressure unit for rapid testing of valves, boilers, piping pressure vessels.
- Sustains constant pressure on Rolls, Rams, Presses.
- Portable for site testing.
- Water, Oil, Diluted Alkalis or Acids can be used.
- Made of non-ferrous metals and stainless steel.

Also 6 JUNIOR MODELS

Fluid pressures 400 psi to 10,000 psi $185.00 f.o.b. New York

DAVIES BROS. 120 WALL ST., N.Y. 5, N.Y.

External Adjustment & Calibration on PRESSURE & VACUUM CONTROLS H5 H12



TYPE H5

TYPE H12

UNITED ELECTRIC designed these controls for industrial applications where outside adjustment and calibration are important factors. Types H5 and H12 accurately and sensitively control liquid level alarms and air gas pressures. The type H5 (minimum 2 psi differential) controls up to a maximum of 500 psi, and the type H12 (minimum 3" wc differential) up to 180 psi. Uncalibrated, internally adjusted versions of these controls are available as type J7 and type J6 respectively.

Switch Differential	H5 — Uniform on-off differential, fixed from 2 psi to 30 psi. H12 — Uniform on-off differential, fixed from 3" wc to 2 psi.
Switch Ratings	15 amps. at 115 or 230 volts AC, also 20 amps. or DC switches on specification.
Switch Types	N.O., N.C., or Double Throw, no neutral position.
Size & Weight	H5 — 5⅜" x 4⅞" x 1½" . . . weighs approx. 1 lb. H12 — ¾" x 2¾" x 5" weighs approx. 1 lb. 6 oz.
Electrical Connection	Conduit opening in enclosure — ⅞" O.D. Internally-located terminal block.
Enclosure	Die-cast aluminum case with black wrinkle finish.
Mounting	H5 — Directly, by ¼" female NPT on bellows housing; or surface mounted by mounting ears on each end of case. H12 — Directly, by ¼" female NPT on bellows housing.
Bellows	H5 — Spring loaded, seamless brass, stainless steel or monel. H12 — Spring loaded, seamless brass bellows.
Pressure Connections	¼" female NPT.

UNITED ELECTRIC *manufactures a complete line of temperature, pressure, and vacuum controls. UE will gladly modify or custom-build a unit to meet your specifications. Consult a UE application engineer today.*

Write for Bulletin No. 5-5 for complete H5 data and Bulletin No. 5-2 for complete H12 data.

UE® United Electric Controls COMPANY

80 SCHOOL STREET, WATERTOWN, MASS.

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Circle 145 on Reader Service Card

COMING IN JANUARY.....*Designers' Guide*

ANSWERS TO THOUSANDS OF QUESTIONS FOR FLUID POWER DESIGNERS

Every day mail addressed to our editors brings requests from readers asking who makes a valve, cylinder, pump, motor, accumulators, etc. in given size, given pressure range, given flow rate, given size or type of port threads. Literally thousands of questions asking "Who makes it —where can I get it?"

To help answer these and to make it simple for many other thousands of designers to get their answers quickly and easily, APPLIED HYDRAULICS will publish in January fifty pages of charts providing quick guides to product selection.

25 QUICK GUIDES TO PRODUCT SELECTION

Quick guide selection charts for the following twenty-five products will be one of the major features of the January, 1957 issue of APPLIED HYDRAULICS. These guides will cover:

Accumulators
Cylinders, Air
Cylinders, Hydraulic
Electric Motors
Electric Timers
Filters, Compressed Air
Filters, Hydraulic
Fluid Line Joints
Fluid Motors, Gear
Fluid Motors, Piston
Fluid Motors, Vane Type
Hose Fittings & Assemblies
Hyd. Fluids, Petroleum Base
Hydraulic Fluids, Synthetic
Limit Switches
Packings
Pressure Switches
Pumps, Gear
Pumps, Reciprocating Plunger
Pumps, Rotary Piston
Pumps, Vane Type
Tube Fittings
Valves, Direction Control
Valves, Flow Metering
Valves, Pressure Control

Issue of APPLIED HYDRAULICS

CHARACTERISTICS DESIGNERS NEED TO KNOW

The chart for each of the twenty-five products will list what companies make the product and will indicate characteristics like these:

a) Type of service
b) Pressure rating
c) Flow range
d) Port sizes
e) Mountings
f) Operating and construction features pertinent to each of the products

REVISED FLUID POWER CIRCUITS ALSO IN JANUARY

The Fluid Power Circuits published three years ago, and for which over 15,000 reprint orders were received, have been revised and will also be published in the January, 1957 issue. This section will illustrate 100 different circuits covering 32 pages. A description of the operation will be given. Here is another valuable working tool for all fluid power designers.

FOR ADVERTISING RESULTS

Here will be an issue that no fluid power advertiser will want to miss. Here in a single issue are the elements of valuable reference for designers and engineers throughout the more than 30 major industries that are large users of hydraulics, pneumatics and electrical controls.

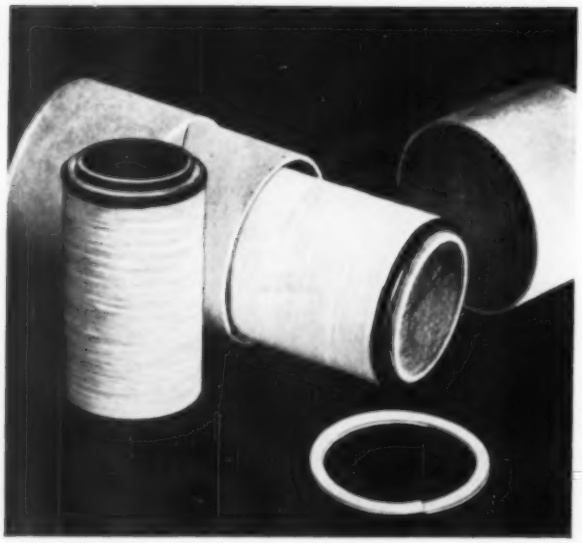
The charts and the circuit diagrams will help the reader select the companies making the products with the characteristics in the range of those required for the particular application. The circuit diagrams will assist in arranging the components within the different circuit requirements. Advertising in this issue can pinpoint exact and desirable product specifications. Here will be an issue of long reference value.

APPLIED HYDRAULICS *Readers: You'll use the Designers' Guide issue throughout the year to assist you in selecting products and circuits.*

APPLIED HYDRAULICS *Advertisers: Put this January issue on your* 1957 *schedule now. Advertising deadline is December* 10, 1956.

for Military Standard

TEFLON® SPIRAL BACK-UP RINGS



specify FLUOROFLEX®-T because...

- These rings are produced to military standard drawings MS 28782 and MS 28783 under exacting inspection controls.
- Both tube stock and machined rings are individually annealed to relieve internal strains and to assure compliance with aircraft dimensional stability requirements.
- This quality controlled method of manufacture provides rings with *all* properties *certified** to AMS 3651 specification.
- Rings are packed in protective telescopic containers on supporting mandrels to preserve shape and dimensions to facilitate installation.

Complete range of sizes for use with AN 6227, AN 6230 or MS 28784 "O" rings. Send for data.

**Photostatic copies of test reports are available upon request.*

®DuPont trade mark for its tetrafluoroethylene resin.
®Resistoflex trade mark for products from fluorocarbon resins.

RESISTOFLEX
CORPORATION

ROSELAND, N. J. • WESTERN PLANT: BURBANK, CALIF.

SUMMARIES OF NCIH PAPERS

The problem of designing individual components is discussed briefly, as well as the fundamental difficulties involved in setting up mathematical or physical models for obtaining the desired data. The balance of the discussion covers techniques for analyzing over-all systems. This includes frequency and transient-response methods for analyzing linear systems and the limitations of these methods, and methods for handling nonlinear systems and random input signals.

In closing, the importance of modern machine methods for problems where suitable analytic techniques have not yet been developed, is discussed.

• POWER STEERING FOR OFF THE HIGHWAY VEHICLES

by Ralph M. Lehman, Assistant Sales Manager, Ross Gear and Tool Company, Inc.

A brief review of the development of power steering is given, and a discussion of the three

Ralph M. Lehman

general classifications of power steering devices. These systems are classed as the integral system, the linkage system, and the combination integral and linkage system.

The integral system has given good service, and is attractive to the design engineer because of the simplification of the hydraulic piping, reversibility of the steering system, and installation of a package unit. However, with the increase in size of vehicles, the integral unit may become too bulky and costly.

With the development of the linkage system, further expansion of power steering was made possible. The main advantages of this system are flexibility and simplicity of field installation.

The combination integral and linkage system has received the least publicity, and was not considered by chassis engineers until recently. This hybrid unit can offer the engineer many advantages, such as better vehicle control, serviceability, and standardization of power steering gear for various model vehicles.

In future designs of off the highway vehicles, all of these systems will have a place. There will be further refinements of present designs, and central hydraulic systems will be given consideration.

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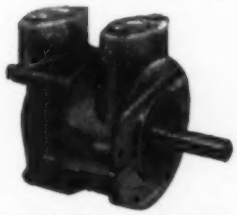
Circle 59 on Reader Service Card

GRESEN HYDRAULICS

VANE PUMPS

With Dual Vane Feed



For Mobile, Industrial, Agricultural Uses

SPECIFICATIONS
3-6-9-12-16-20-24 G.P.M.
Max. 2000 R.P.M.

ROTATION
Clockwise-Counter Clockwise
Mounting Feet Available

Write for literature

GRESEN MANUFACTURING CO.
628 Colfax Ave. N. Dept. H-16 Minneapolis 11, Minn.

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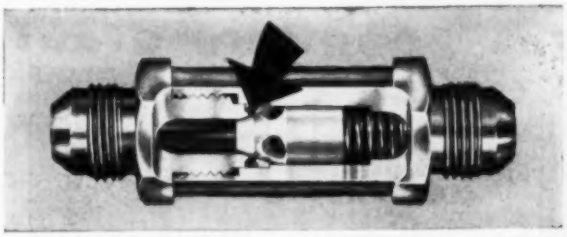
Simple, Secure . . . Leak-Tight!

The FLEXIBLE SEAL SEAT*



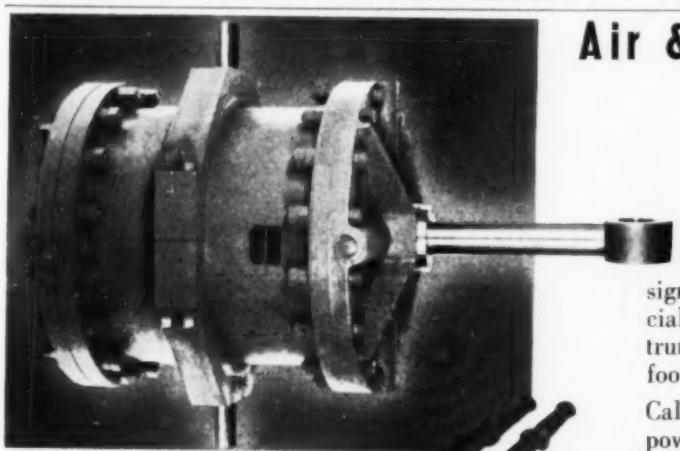
Responsive action of the soft O-ring seal provides absolute leak-tightness. Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts; no extra end seals. Stocked in 6 standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Write for data sheet.

KEPNER PRODUCTS COMPANY
7321 West 59th Street • Summit, Illinois

Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR



Stroke—13½ Inches
Diameter—24 Inches
200 P.S.I. Air Pressure

Length: 34 Ft.
Diameter: 7 In.
1500 P.S.I.

Air & Hydraulic Cylinders

• FOR HEAVY-DUTY APPLICATIONS OF ALL TYPES • TO MEET ALL SIZE AND PRESSURE REQUIREMENTS • BORES TO 32" DIAMETER • STROKES OF 50 FT. AND LONGER.

Lincoln Machine Company will design, engineer and build standard or special hydraulic and pneumatic cylinders with trunion, rod-end flange, blank-end flange, foot, clevis or centerline mountings.

Call on Lincoln when you require large, powerful rotating or non-rotating hydraulic and air cylinders, heavy-duty mill-type cylinders. Our engineering department will give you fast, practical assistance in design problems . . . and our modern plant will build your cylinders quickly and economically.

Write today for Lincoln's catalog. It gives engineering data on many types and sizes of heavy-duty cylinders.

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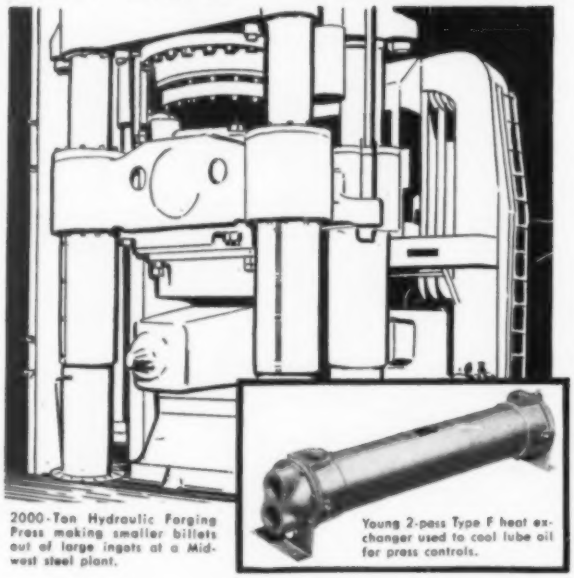
Young Cools Controls For 2000-Ton Giant



2000-Ton Hydraulic Forging Press making smaller billets out of large ingots at a Mid-west steel plant.

Young 2-pass Type F heat exchanger used to cool lube oil for press controls.

Young Heat Exchanger Cools Controls for Hydraulic Forging Press

Every time this monster press slams down its 2000-ton fist, it responds to the accuracy and efficiency of master press controls. All component parts of these vital controls must be of absolute dependability. For this reason Young Type F heat exchangers were specified to cool lube oil for the press control motors.

Besides their reputation for dependability, compact Young heat exchangers offer greater initial and operating economies, and more cooling surface per unit volume of space. Construction features include: (1) Smooth flow bonnet that distributes fluid with minimum turbulence; (2) Corrosion-resistant tubes brazed into casting; (3) Quality gasket eliminates fluid by-passing or leakage; (4) Baffles made to close tolerance. Model F available in stock for immediate delivery, or removable tube bundles built from standard stock parts. Both available for fresh or salt water.

Write for FREE Catalog #1254

Put Young Talent to work for you . . .

Solving heat transfer problems is what we do best because it is our very reason for being. You, too, can harness the power of Young engineering talent. Write, wire or call without obligation.

Dept. 446-K

Young RADIATOR COMPANY
RACINE, WISCONSIN
Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY
Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.
Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Matteson, Illinois

SUMMARIES OF NCIH PAPERS

● HYDRAULIC CONTROL OF AUTOMATIC MASS PRODUCTION TOOLS

by Ernest J. Svenson and A. B. Riddiford, Jr., John S. Barnes Corporation

An explanation will be given of the various automatic machines, unitized structures, hydraulic and electrical controls, and terminology used.

A specially produced film, showing actual operation of machines, will dramatize mass production

Ernest J. Svenson

A. B. Riddiford, Jr.

in the automotive industry. The firm will stress built-in maintenance, safety, efficiency, accuracy and unitized, automatic, self-contained structures.

There will be a general discussion on progress through the use of automatic machines, and economic possibilities they offer. The Barnes automatic, self-contained unit structure will be explained, including automatic, hydraulic and electrical controls and associated elements.

● VAPOR-LIQUID RATIO GAGE

by Richard K. Stoms, Project Engineer, Cincinnati Division, Bendix Aviation Corporation

Utilizing the principle of absorption of gamma rays from a radioisotope, this gage measures the vapor-liquid ratio in aircraft fuel lines. This gage

Richard K. Stoms

is specially useful, as there are no sensing elements or obstructions placed in the fuel line.

Actually, the apparent density of the material in the fuel lines is measured. This apparent density is a function of the density of the liquid fuel and the vapor-liquid ratio. If the fuel density is as-

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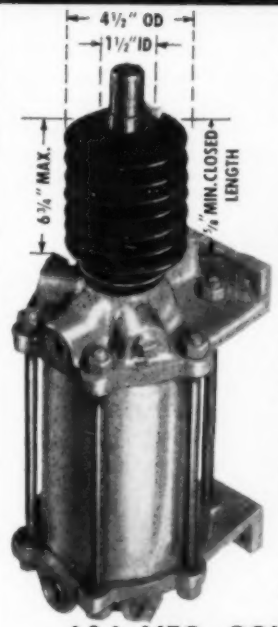
PROTECTION
GORTITE PLIABLE PARTS



Fabricated from neoprene-base materials GORTITE sleeves can be supplied in all lengths to stack into min. closed thicknesses.

HIGH MAX. LOW MIN.

And, too, GORTITE sleeves and way-protectors last from three to five times longer than molded rubber.

1 OR 1000 NO MOLDS

New bulletin SPC-2 sent promptly on request.

A&A MFG. COMPANY INC.
2017 W. Clybourn St., Milwaukee 3, Wisconsin

3000 psi won't get by the threads of Allen ⬡ Dryseals!

ALLEN 'TRU-ROUND' Dryseal Pipe Plugs

formed from special analysis ALLENOY steels.

Sold only through leading industrial distributors—specify genuine Allen Dryseal Pipe Plugs.

standard sizes from 1/16" to 1-1/4"

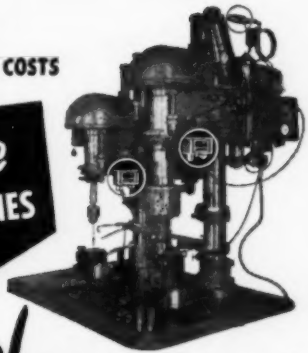
Here's the dependable, metal-to-metal seal you need for hydraulic systems . . . for transmission, control, and automated mechanisms where pressures run high. The N.P.T.F. threads of Allen ⬡ Dryseal Pipe Plugs are smooth, burnished, and burr-free — do their job without any help from sealing compounds. Allen's unique "pressur-forming" process assures the highest degree of precision threading and dimensional accuracy. What's more, Allen ⬡ Dryseals are precisely round at root, pitch and crest, with taper held to extremely close tolerances.

Allen engineers will gladly help you to harness your hydraulic pressures. Just write.

ALLEN
MANUFACTURING COMPANY
Hartford 2, Connecticut, U.S.A.

FOR MORE PRODUCTION..LOWER COSTS

Automate YOUR MACHINES with Pneu-trol



Standard drill press units converted for automatic push-button precision tapping and spot-facing operations. Production increase—400%!

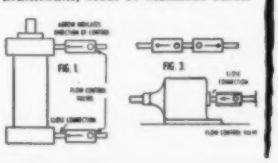
"AUTO-PONENTS"

Pneu-Trol Flow Control Valves and Time Delay Control Switches are *basic automatic components* which permit low-cost conversion of any cylinder operated drill press, arbor press, punch press, etc. to automatic operation. They provide these advantages:

1. **Cylinder (and machine) speed control for safe operation.**
2. **Necessary controlled work cycle delay.**
3. **Less spoilage . . . more production from your present equipment.**
4. **PUSH BUTTON PRODUCTION.**

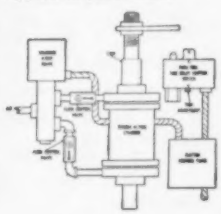
FLOW CONTROL VALVE FOR CONTROLLED CYLINDER SPEED

Pneu-Trol Valves combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control, and a floating retro ball check, which permits full flow in the opposite direction. Design provides close regulation in one direction, full flow in opposite direction. Available in 5 female pipe sizes—⅛" to ⅜". Valve bodies made of brass, aluminum, steel or stainless steel.



TIME DELAY CONTROL SWITCH FOR PRECISE DELAY OF WORK CYCLE

Provide controlled adjustable time dwell of solenoid operated air or oil supply valves. Range between ¼ and 60 seconds in 20 to 1 ratios. Compact—simple—foolproof—rugged. Easily mounted on machine. Available for various types of actuation. Typical diagram below.



Pneu-trol DEVICES, INC.
Components for Automation
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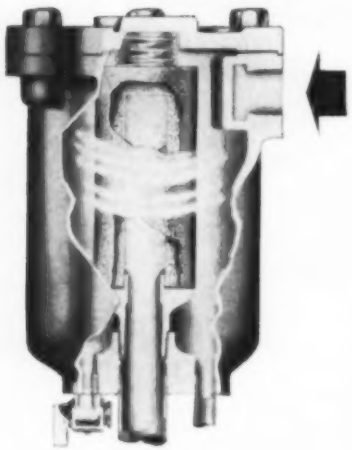

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● HIGH TEMPERATURE HYDRAULICS

by D. B. Gardiner, Director of Research and Development, and F. L. Moncher, Chief Engineer, Airborne Products, Vickers, Inc.

Supersonic aircraft flight is expanding the operating temperature ranges for airborne hydraulic equipment. Present temperatures of −65°F to 200°F are being extended to 550°F, and possibly 1000°F, in the future. The weight penalty for maintaining lower ambient and fluid temperatures in the hydraulic system justifies considerable expenditure of time and effort in designing components that are compatible with the high temperatures.

Frank L. Moncher

Duncan B. Gardiner

Design problems for high temperature equipment are very complex, and intensified by the trend toward high operating pressures and space limitations. The fluid must be chemically stable at high temperature, resist corrosion, and be compatible with seals and other materials. Materials used must be of minimum weight to be usable, but must also withstand high stress levels.

The discussion also covers the development of test equipment for the evaluation of equipment at high temperature. It was necessary to develop new test facilities, techniques, and equipment to simulate actual ambient conditions with thermal cycles of rapidly varying amplitude and period. Design approaches to these problems are discussed, including possible uses of new materials.

● DO YOU NEED FIRE-RESISTANT FLUIDS IN YOUR PLANT?

by George M. Woods, Special Engineer, Factory Insurance Association

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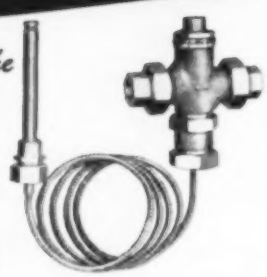

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SUMMARIES OF NCIH PAPERS

petroleum fluids in hydraulic operations are reviewed. It is necessary to analyze each application individually to determine whether low hazard fluids are essential. Where the fluids do not lend themselves to objectionable conditions and the building construction and normal occupancies are favorable, normal petroleum fluids may be permissible where acceptable fire extinguishing systems are installed.

With the great increase in the application of hydraulic fluids, it is essential that each user review his specific applications and consider any possible hazards. In addition to lost production time and property damage, danger to operating personnel should be considered. Modern fire extinguishing systems can protect buildings and equipment, but may not operate quickly enough to prevent serious injury to personnel.

• FIRE HAZARD EVALUATION OF HYDRAULIC FLUIDS

by A. F. Matson, Managing Engineer, Chemical Department, Underwriters Laboratories, Inc.

Hazardous properties of fluids relating to fire and explosion are measured and correlated to determine the fire hazard of a hydraulic fluid. These properties include volatility, ignition temperature, flammable limits, combustion intensity, flammability in the form of sprays or streams, vapor density, and stability.

A. F. Matson

William H. Millett

The discussion covers the important hazardous properties of fluids, and also describes the methods of conducting the various tests required.

• ASTM LOOKS AT FIRE RESISTANT HYDRAULIC FLUIDS

by William H. Millett, Sales Manager, Ucon Products, Carbide and Chemicals Company

The American Society of Testing Materials is recognized for its pioneering work in the development of standards for products used by American industry. Therefore, the recent formation of a Technical Committee on Hydraulic Fluids should be of considerable interest to users of fire resistant hydraulic fluids. The organization of Technical

Committee N on Hydraulic Fluids as an integral part of ASTM Committee D-2 on Petroleum and Petroleum Products represents concerted effort by fluid suppliers and users to establish meaningful standards in this complex field.

• DEVELOPMENT OF A HYDRAULIC STARTER FOR CRANKING DIESEL ENGINES

by John H. Smith, Section Head, Hydrostarter Engineering, Aeroproducts Operations, Allison Division, General Motors Corporation

The various phases of development of a swashplate type hydraulic starting motor are presented.

R. M. Tuck

John H. Smith

The preliminary design phase established the motor requirements and certain factors to guide the development. The prototype motor phase was first concerned with the motor. Then the control valve was developed, and finally the necessary parts for adapting the motor to an engine for starting tests. Later phases covered design refinements and a more adaptable starter unit for field test experience on various engines.

In this system the starting motor is a swashplate type hydraulic motor, powered by a hydraulic accumulator. The complete starting system contains additional components which provide for automatic recharging and emergency recharging of the system.

• TORQUE CONVERTERS FOR COMMERICAL APPLICATION

by R. M. Tuck, Development Engineer, Transmission Engineering Division, Allison Division, General Motors Corporation

A range of commercial applications for torque converters is reviewed, and the requirements the various jobs impose on the design. Absorption flexibility is required due to the range of engine sizes to be met. The principles used by the torque converter designer to provide these requirements are discussed.

The tools available for analysis and development of torque converters are also discussed. This includes the use of electronic calculating equipment for analysis, and special laboratory equipment for the evaluation of blading combinations. ▼▼▼

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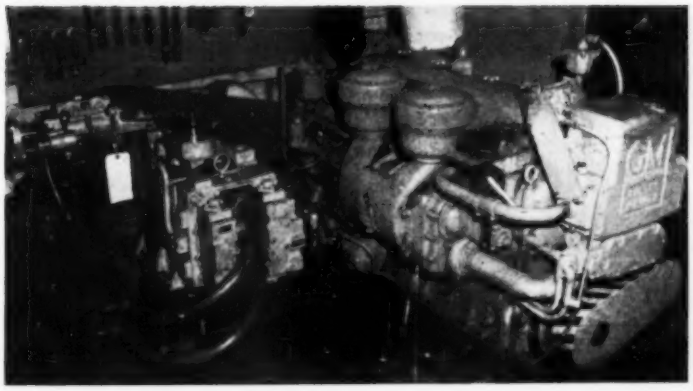
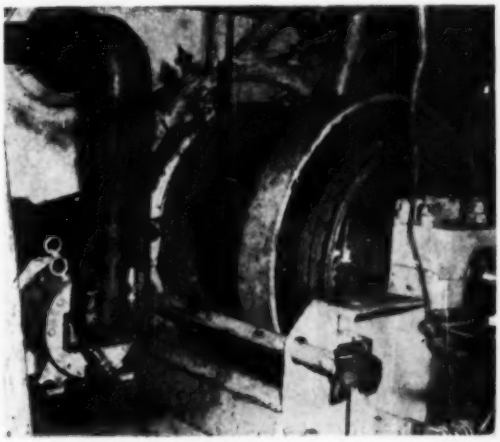


VARIABLE DELIVERY PUMP is driven through a chain drive by a diesel engine. The pump is controlled by a pneumatic positioner which is remotely controlled from the bridge of the vessel.

CONSTANT DISPLACEMENT hydraulic motor drives a two-drum winch through a chain drive. The motor speed, direction and power are controlled by the variable delivery pump located in the engine room of the vessel.



Lifting a 14 ton buoy and sinker out of the water requires reliable control. This drive does the job with a full range of stepless speed control.

200 HP DRIVE

...reduces hoist cost

• By R. J. Mitchell

THE U. S. Coast Guard Tenders "Walnut" and "Hollyhock" have recently had their buoy hoists equipped with variable speed hydraulic transmissions rated at 200 hp for intermittent duty. The hoists are used to remove buoys for servicing, overhaul or storage.

The hydraulic drive provides smooth and reliable handling of the buoys both in removal from the water to the deck of the Tender and from the deck to the pier.

Each hoist consists of a double drum winch located in the hold. Each

R. J. MITCHELL, *Application Engineer, Waterbury Tool Division of Vickers Inc., Waterbury, Conn.*

SAVINGS in space and installation costs were obtained when hydraulic transmissions were installed in the U. S. Coast Guard Tender WALNUT to power the buoy hoists.

vessel is equipped with two such winches. The boom is mounted on a gooseneck swivel on the weather deck, and is controlled by the topping drum of each winch. Two purchases are available for lifting the load. Both are three-part tackles for normal loads, and are operated by one drum on each winch. For heavy loads one purchase can be rigged with a five-part tackle.

The buoys weigh from 2 to 12 tons, and have sinkers attached, which weigh from 500 pounds to 2-1/2 tons. In addition to these loads, considerable lift is required to break the sinkers and chain loose from their anchorage.

. . . for a given load, this transmission gives a constant torque output . . . system pressure varies with load to change torque . . . speed varies with oil delivered to motor . . .

The power source for the hydraulic drives are diesel engines, having an 180 bhp rating. A chain drive reduces the 1800 rpm diesel engine speed to 1200 rpm for the hydraulic pump.

The hydraulic transmissions consist of a variable displacement reversing pump driving a fixed displacement reversing motor. As shown in the schematic drawing, the system is a basic closed loop circuit. Integral with the main pump, and driven from its shaft, is the auxiliary pump used for:

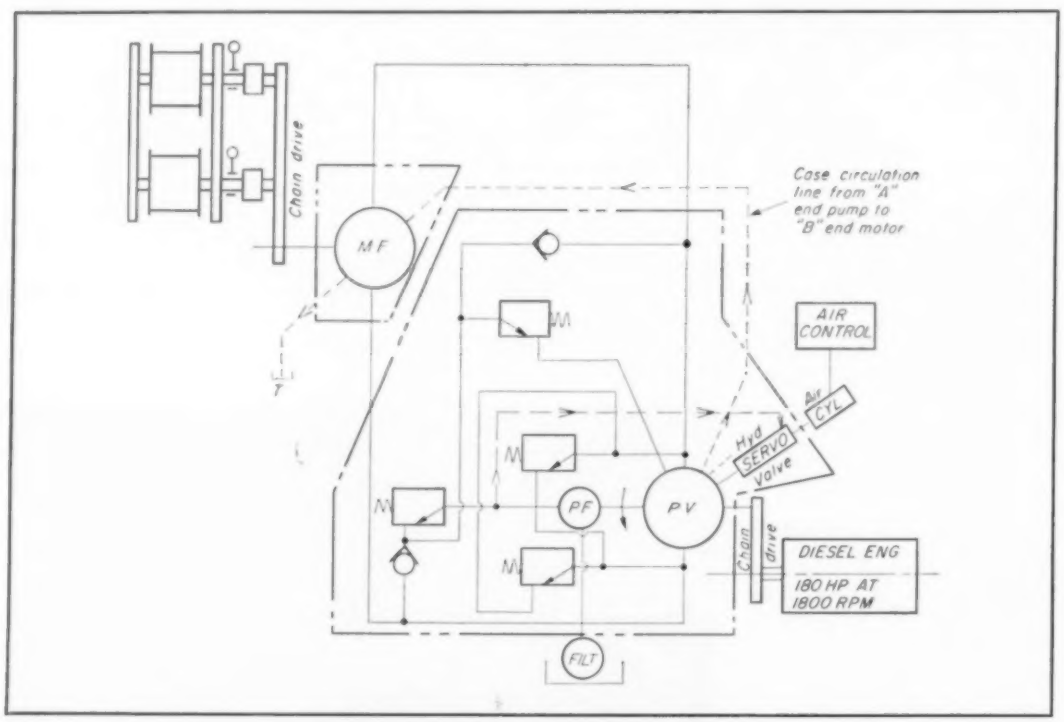
1. Servo valve which controls the stroke of the pumps.
2. Supercharging of the active system through replenishing valves built into both the pump and motor.
3. Circulation of oil through the cases of both pump and motor for both lubrication and cooling.

The control stand for the hoists is on the bridge of the Tender. An air control system operates the servo control valve on the pump, as well as engine throttle, winch clutches and brakes, for performing the various control motions.

Handling heavy buoys in a seaway can be a dangerous operation to both personnel and equipment. Smooth, positive and reliable control is required, to assure proper timing in lifting the buoy from the water and swinging it aboard. Part of this problem is the need for rapid acceleration, which the hydraulic drive provides adequately. Slow lowering speeds for setting the buoy on the tender's deck and in the hold, without doing damage, is also of prime importance.

After completing last winter's and this spring's "Buoy Runs", the "Hollyhock's" skipper reports very satisfactory operation.

On this application use of the hydraulic drive, in conjunction with the diesel engine, reduced the size of the auxiliary electrical plant. It is reported that this brought about a reduced cost and space savings in the overall installation of the hoist machinery. ▼▼▼



WINCH is driven by this closed loop circuit.

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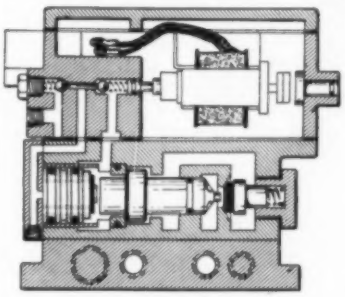

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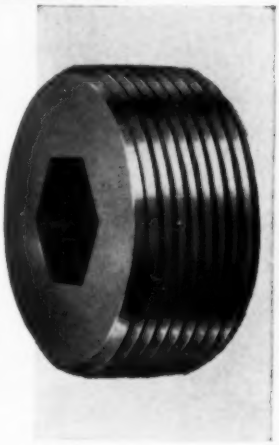

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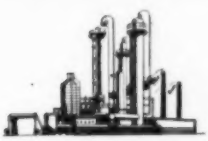

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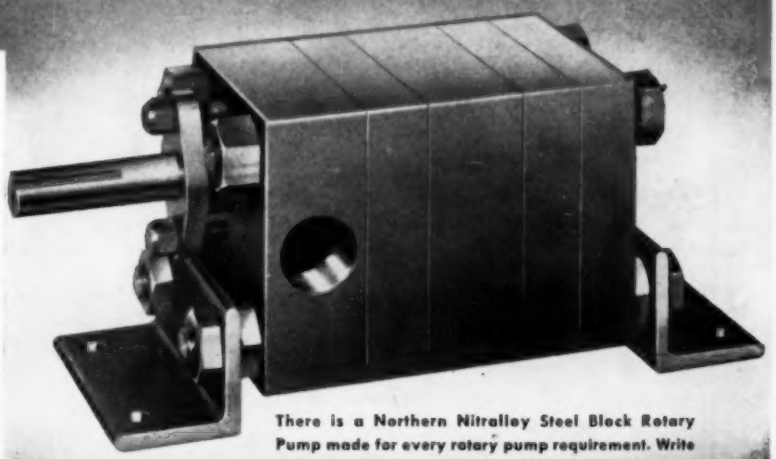

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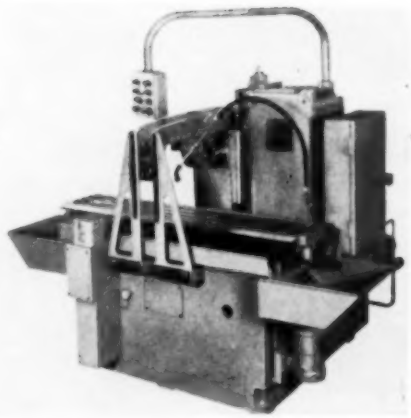
APPLIED HYDRAULICS

CIRCUIT DESIGN ARTICLE

"NO JUMP" CIRCUIT

to smooth motion of machine table

When a conventional meter-out circuit is started in feed, there is a jump until the compensator moves in to control the drop across the metering orifice. To solve this feed problem Sundstrand Machine Tool Company has a . . .



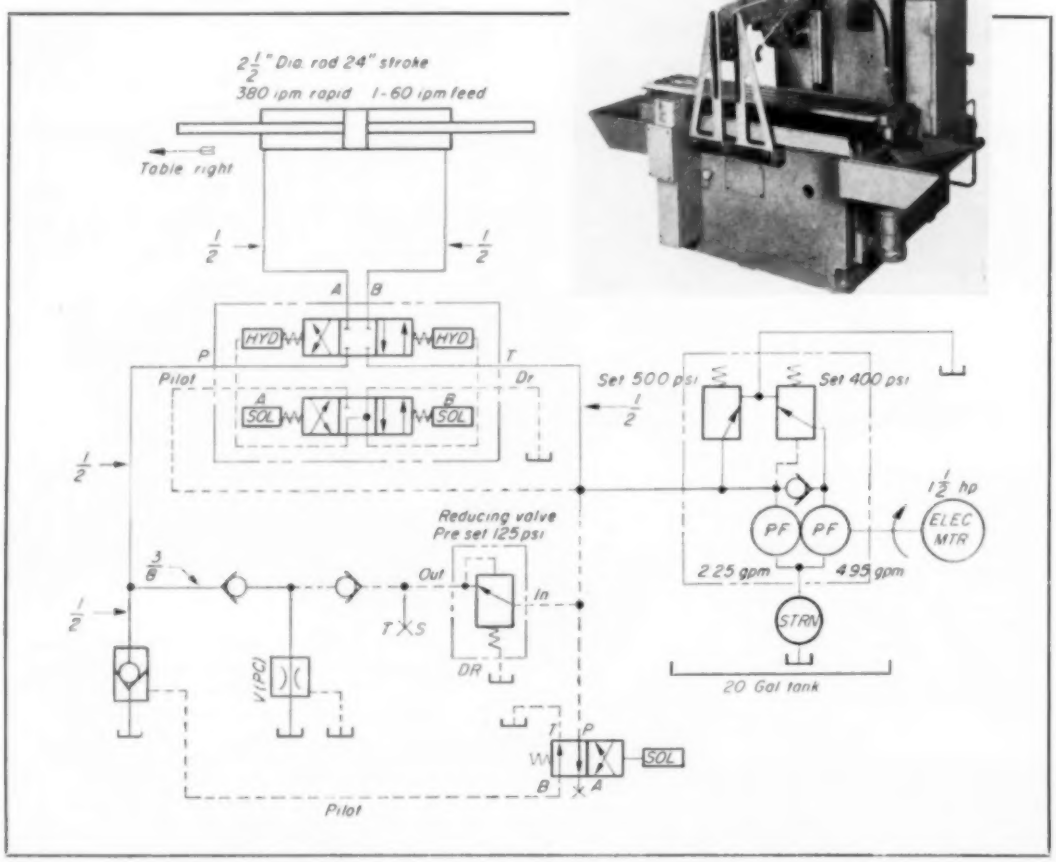


FIG. 1. Feed control circuit is used on a line of 5 hp horizontal milling machines.

• By David Hutchinson

USE of the pressure reducing and check valve arrangement in the feed circuit shown in Figure 1 permits the machine table feed cylinder to start without the usual jump that occurs before the compensator of the flow control valve can reach a controlling position.

This circuit adaptation was developed for a small mill on which setup of many jobs is done. During setup the machine is jogged in feed. The "no jump" circuit eliminates skip of the table when the operator jogs the control. It also helps to prevent tool breakage which is sometimes caused by overload during the jump.

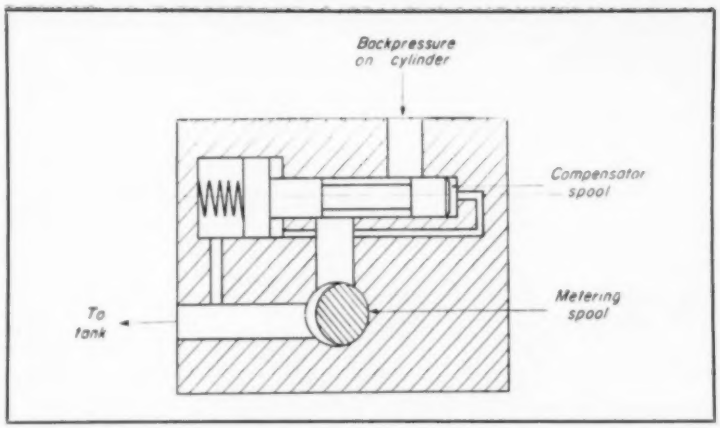


FIG. 2. Constant pressure drop across metering orifice is maintained by compensator spool regardless of work load. However, compensator will be full open and not in control of pressure drop if pressure into the valve is less than required to overcome the compensator spring.

Speed of the hydraulically driven table depends on the rate of oil flow out of the table cylinder. Therefore, smooth controlled feed rate depends on accurate constant flow control.

Successful use of fluid driven tables on machine tools is largely the result of application of pressure compensated flow control valves. Assuming constant oil temperature, flow control through an orifice depends on orifice area and the pressure drop across the orifice. Controlling orifice area is no problem. But holding the pressure drop constant during total table travel under varying load conditions can be difficult. The pressure compensated flow control valve which has been in use for many years is designed to maintain a constant pressure drop across the metering orifice regardless of changing work load.

Characteristics of the meter-in, meter-out and bleed-off circuits have been discussed in many articles. The meter-out circuit is widely used to control feeds of milling machine tables where a backpressure is desirable to assure smooth action.

This meter-out type of circuit with the "no jump" feature is applied on the new 5 hp, Cl Rigid-mils, Figure 1, designed by Sundstrand Machine Tool Company. The circuit variation keeps the compensator in action at all times and thereby prevents jumping which does occur in the conventional meter-out circuit when the circuit is started in "feed".

Figure 2 is a schematic of a pressure compensated flow control valve showing the pressure relationships for a meter-out circuit. With a conventional meter-out circuit, the compensator spool is full open when this system is started in "feed". This allows a spurt of oil through the valve until the compensator moves to control the pressure drop across the orifice. During this moment, the table jumps.

With the "no jump" circuit, the compensator is maintained in a controlling position at all times by always supplying the flow control with oil. When the cylinder is not moving, the oil from the reducing valve passes through the check and acts on the compensator spool. Shifting the main 4-way valve starts the cylinder moving only after more than 125 psi backpressure is built up to close the check to the reduced pressure circuit. This enables stopping and starting the table feed without the jump which is usually experienced with a flow control valve.

This 125 psi backpressure does, of course, reduce the available net force for doing work. However, since the compensator of a flow control valve does not function well at pressures below 100 psi, nothing is lost. ▼▼▼

DAVID HUTCHINSON, *Hydraulic Engineer, Sundstrand Machine Tool Co., Rockford, Illinois*

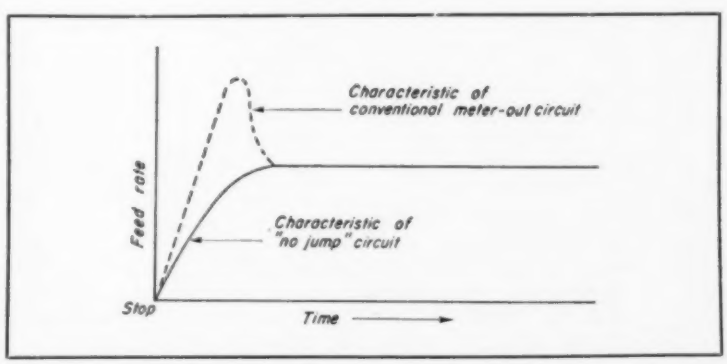


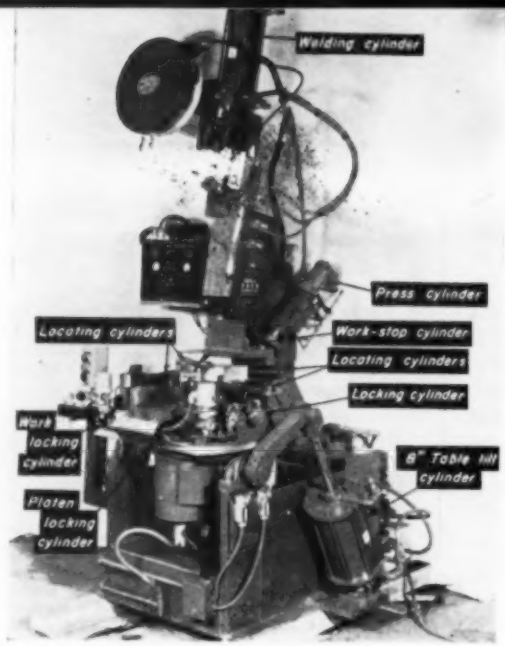
FIG. 3. Plotting feed rate against time shows the jump in a conventional meter-out circuit at the start of feed. The "no jump" circuit smooths out the curve as the operator jogs the start button.

Requirement:

Weld 50 compressor housings per hour with a 45-second weld time.

Solution:

An automatic machine with 11 cylinders to index, locate, and clamp the work.



FIVE PNEUMATIC TIMERS control actuation of solenoid operated air valves to control welder cycle. Because of dimensional tolerances, several actions are required to locate the workpiece before it is clamped.

ELECTRO-PNEUMATIC CIRCUITS

for a welder

• By C. R. Chew

VERSATILITY of pneumatic cylinders with electrical control is shown in a machine built for production welding. With the exception of table rotation, all movements are accomplished with air. Eleven cylinders with solenoid control are used to index, locate, and clamp the work, and to position the welding head.

This machine was designed and built at Cecil C. Peck Co., Cleveland, Ohio to automatically weld hermetically sealed compressor housings for refrigerators. Required production was 50 units per hour. To accomplish this with time allowed for manual loading and unloading, the machine cycle time had to be slightly less than one minute. Welding time was approximately 45 seconds. Thus a maximum of about 10 seconds was allowed for locating and clamping. After manual loading of the work on the table, the cycle is completely automatic. The sequence of operations is maintained by pneumatic time delay relays. These timers have the required accuracy of repetition and are economical to use. The time interval can be varied by a screw-driver adjustment.

The workpiece consists of two deep-drawn halves, each approximately the shape of a hemisphere. Referring to the open ends of these hemispheres, the ID of the bottom half and the OD of the top half form a press fit. After assembly of a motor and pump to the bottom half, the top is pressed in. The unit is then ready for welding.

ACCURATE LOCATION DURING LOADING

The problem is to locate the work, so that the joint is always in the same position relative to the welding electrode. Tolerances in the depth of the pieces are such that loading on a constant height is not sufficiently accurate. Consequently the locating has to be done at the joint. After locating, the work has to be locked in place and the welding head brought into position.

Loading is most convenient with the table horizontal. Optimum welding, however, is with the joint at a 45-degree angle and the electrode vertical. This requires tilting the table and providing a work-stop to hold the housing in approximate position prior to locating and clamping. Furthermore, the work-stop has to be retractable to avoid interference during rotation of the work.

Basically the machine is of the turntable type.

C. R. CHEW, *Chief Engineer, Cecil C. Peck Co., Cleveland, Ohio*

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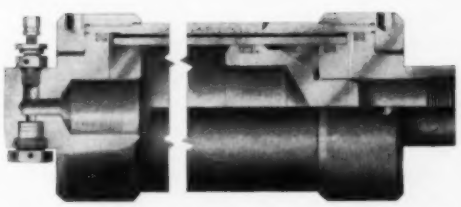
SUPERIOR Piston Type ACCUMULATORS



. . . the safest and most dependable single or double shell accumulators ever developed to offer all of these features:

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- Dashpot Design — decelerates piston travel and eliminates damaging effect of piston shock loads and hammering
- Unrestricted Mounting — units can be mounted in any position
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Piston type units to 5,000 P.S.I. max. working pressure, from 5 to 4,030 cu. in. net gas volume and from 3 to 3,465 cu. in. max. oil working volume.

Standard single shell accumulators, intensifiers and special units can be made to specifications.

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WELDER CIRCUITS

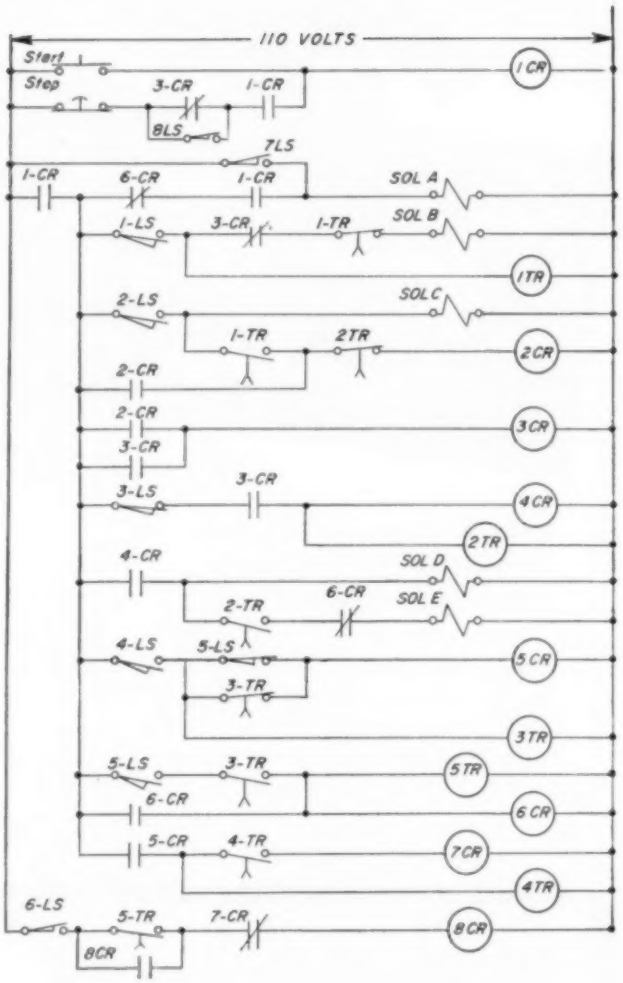
Locating and locking mechanisms are mounted together with their actuating cylinders on the table. A spring-loaded platen in the center of the table supports the work piece. This allows the work to be moved down by a force along its axis. The resulting spring compression pushes the work upward against locating fingers when the force is removed.

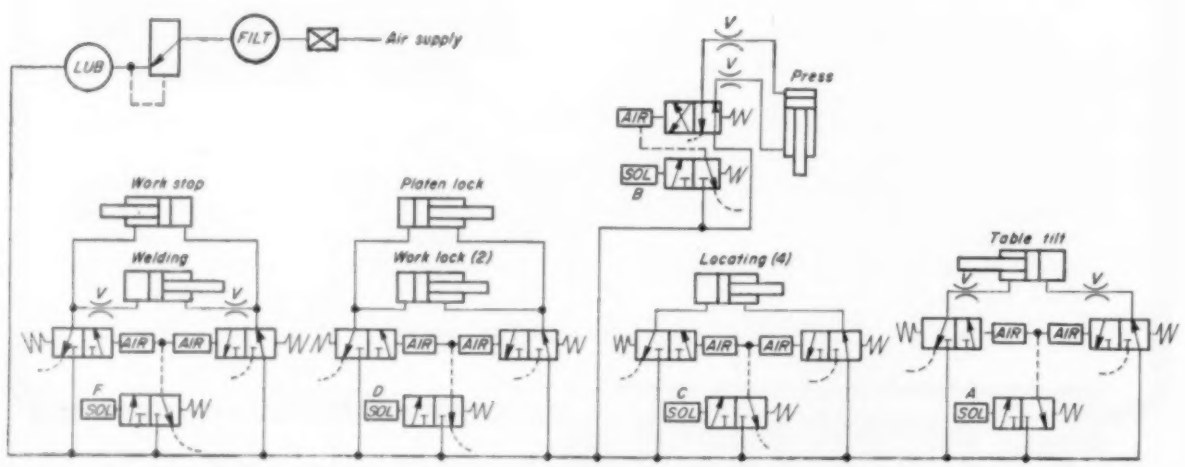
When the press cylinder is fully retracted, the work is locked in position by the two work-locking cylinders. At the same time the platen-locking cylinder locks the spring-loaded platen, so that no further upward pressure is exerted. Some difference in the speed of operation of the two work locking cylinders is possible, but this does not cause any misalignment. The locating fingers hold the housing in position until both locking bars are in contact. Consequently, if one locking bar contacts first, its load is increased and the opposite cylinder moves in faster. After both bars are seated and the motion

Concluded on page 136

LIMIT SWITCH ACTUATION and timer functions are:

1-LS Actuated when turntable tilted to welding position.
2-LS Actuated when press cylinder extended.
3-LS Actuated when press cylinder retracted.
4-LS Actuated when welding head extended.
5-LS Actuated by cam on turntable when weld is completed.
6-LS Actuated by cam on turntable when reversal is com-completed.
7-LS Actuated when welding head cylinder retracted.
8-LS Actuated when turntable horizontal.
1-TR Determines press time.
2-TR Allows time for locking work.
3-TR Bypasses 5-LS the first time it is actuated.
4-TR Delays rotation of work to help establish the arc.
5-TR Prevents plugging of the drive motor.





USE OF 3-WAY solenoid valves and two, 3-way air-operated valves permits savings in cost. Valves are ¼ inch. 4-way valves would have had to be ½ inch. Solenoid-controlled, air-operated valve for press cylinder is ⅜ inch.

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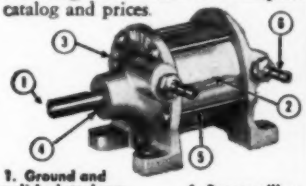

1. Ground and polished steel ram
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GD 30	0-2500	High Delivery Flow Rates. Accurate Valve Control.	Air, Argon, Helium, Hydrogen, Nitrogen, Oxygen —and others non-corrosive to bronze and stainless steel.
GD 31	0-3600		
GD 61B	0-2500	Excellent Capacity. Compact—7 lb.— 4" x 6" x 6". —67° to +160° F. Range.	
GD 62B	0-3600		
GD 80	0-5000	Accurate Valve Control. —67° to +160° F. Range.	
GD 81	0-10000		
GD 10	0-500	Self-Relieving Pilot Regulator Control. High Flow Rates.	
SR 10	0-1000	High Pressure, Low Flow. Compact—4 lb. —2" x 6" x 6".	
SR 100	0-30 & 0-40	Corrosion Resistant.	Ammonia (wet or dry) Boron Trifluoride Chlorine (wet or dry) Hydrogen Sulfide, Hydrogen Chloride, Sulfur Dioxide—and other corrosive gases.

VICTOR'S LONG EXPERIENCE IN PIONEERING HIGH PRESSURE GAS REGULATION *is yours for the asking. For details, and complete data on Gas-O-Dome Regulators, see your VICTOR dealer or write us for catalog 341. Dealer inquiries invited.*

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment, hardfacing rods, blasting nozzles; cobalt & tungsten castings.

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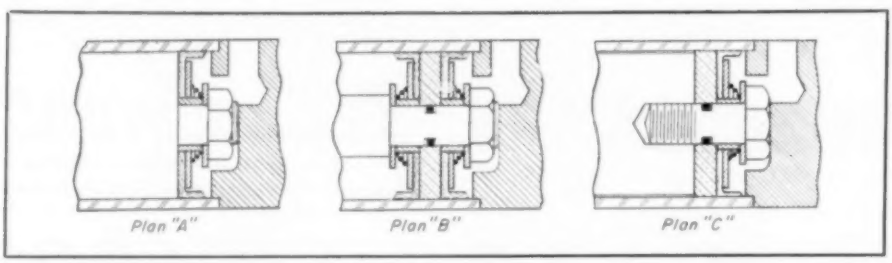
SPRING LOADING

. . . increases cup packing life



Three typical spring loaded cup packings. "A" and "C" are single acting, "B" a double acting cylinder design. In "A" the cup is mounted on the bottom of the plunger. "C" uses a separate back follower so that the bolt should be installed with an "O" ring to prevent leakage. "B" is similar to "C" except that it is for a double acting cylinder.

EXTENSIVE research has established the fact that cup packings operate at maximum efficiency only when they can "breathe" during service. They must be able to expand under the actuating pressure to effect a perfect seal. Then, on the return stroke when the pressure drops to zero, they must contact sufficiently to eliminate rubbing on the cylinder wall.

REDUCE CHATTER AND STICKING

A new theory in mounting cup packings, in which cups are mounted and held in position with light spring pressure is paying dividends by providing better sealing, less friction and longer packing life. This is in contrast to the old idea of using tightly bolted metal follower plates in which the cups had no opportunity to contract or give when the actuating pressure was removed during the return stroke. As a result, the heel or shoulder of the cup was held firmly in place against the cylinder wall during the return stroke, causing chatter, sticking and undue packing wear. Such action made smooth operation of the component impossible.

In many cases, especially when high pressure was being used, it was the general practice when installing cups to apply as much mechanical pressure as possible by tightening the inside follower plate to equal the actuating pressure. When this is done, the bottom of the packing is so deformed and weakened that service life of the packing is materially reduced. Instead of wear being evenly distributed around the heel of the packing, it is concentrated at the corresponding high spots in the cylinder. Also, the squeezing action actually tends to pull the lip of the cup away from the cylinder wall, limiting sealing during the buildup of actuating pressure.

Tests conducted by the hydraulic engineering staff of a leading packing manufacturer have proved that such unnecessary pressure prohibits the breathing action of the cup, compresses and tends to actually cut through the bottom of the packing.

The engineers devised a simple spring mounting

Now—a complete line of small power units

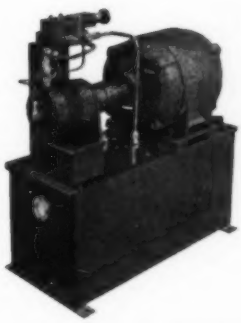
By ROSAEN

These ten-gallon units offer made-to-order specifications at standard prices and delivery

NEW! FOR A CAPACITY OF: **5 gmp at 2000 psi**

with pressure compensation and variable volume features

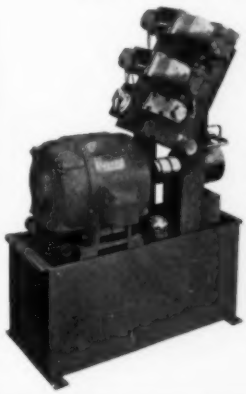
the ST-10



A new high performance power unit with a pressure compensating pump. Automatically reduces oil volume pumped when no work is done, yet maintains full pressure in circuit. Stops heat generation.

A variable volume control may be had to allow various maximum volume settings. Stops waste of power. Pressure and flow compensation gives unit great versatility.

NEW! THE ST-10 UNIT WITH FEED AND TRAVERSE CIRCUIT



A Complete Feed & Traverse Unit

The pressure and flow compensated ST-10 power unit as described at left may be used as a feed and traverse power device in milling, drilling and pressing operations with the addition of a Rosaen circuit. Circuits are complete with solenoids and valves.

Two circuits are offered, one of which will operate a 2 to 1 cylinder, allowing higher traverse speeds. Write today for more information.

FOR FIXED CAPACITIES, FROM: **3 gpm at 500 psi**
TO: **12 gpm at 125 psi**

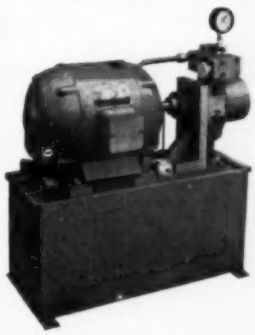
the PT-10

A power unit designed to give you higher operating pressures and better control in your air circuits by converting to hydraulic power. Most air controls need no alteration.

Your choice of ½, ¾, or 1 hp electric motors. Comes on a JIC 10-gallon reservoir with vane-type pump and differential-type relief valve. Write for more information.

FOR FIXED CAPACITIES, FROM: **1.5 gpm at 2000 psi**
TO: **8 gpm at 320 psi**

the DT-10



Here's the complete power unit for heavy-duty, light-cycle work, such as actuating transfer machines.

Available with ½, ¾, 1½, or 2 hp electric motors. Includes a 2000 psi vane-type pump and a pilot operated ventable-type relief valve, on a JIC 10-gallon reservoir. Has a heat dissipation capacity of ¾ hp. Write for more information.

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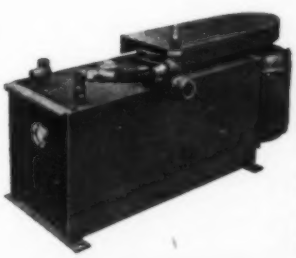
TO: **12 gpm at 250 psi**

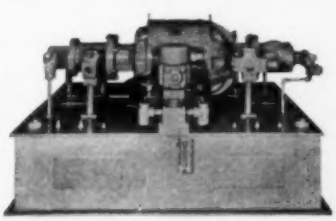
the DY-10



Assemble this unit yourself, and save the cost of the electric motor. Use it to power presses, brakes, riveters, etc. You'll never buy hydraulic power at lower cost than with the DY-10.

Designed to allow easy assembly, it boasts a two hp electric motor, a belt driven gear-type pump, relief valve, and a 10-gallon reservoir.

Larger Rosaen Units



The Rosaen Company catalogs standard power units with up to 30 hp and 100 gallons in capacity (model designation PT). We quickly assemble these units upon receipt of order, from standard tanks and accessories now in stock. Ask for a catalog list.

Special power units (such as the one shown) are regularly designed and constructed in any number or size. Be sure you get a quote on your special work from Rosaen.

ATTENTION DEALERS
Write us for dealer information

The ROSAEN COMPANY
1756 EAST NINE MILE ROAD • HAZEL PARK, MICHIGAN

Circle 119 on Reader Service Card

NOW—AN ENTIRELY NEW *Bendix-Skinner* HYDRAULIC OIL FILTER

Approx. ½ size

OFFERING YOU FINER FILTRATION AT LOWER COST!

Here's everything you've wanted in a filter, including a built-in bypass—and all at a price equivalent to only six quarts of hydraulic oil! Yes, this newest addition to the Bendix-Skinner* line is truly the last word in efficient, yet economical, filtration. Its sturdy aluminum die cast construction assures long service—trouble-free, because it is available with either cleanable "ribbon" type elements for 40-micron filtration, replaceable "pleated" type for 10-micron filtration, or "disc" type, cleanable in 5 or ½ microns. Two ¼-inch N.P.T. inlets and two ¼-inch N.P.T. outlets make installation quick and easy. Operating pressure—100 p.s.i. Complete flow rate-pressure drop data on request.

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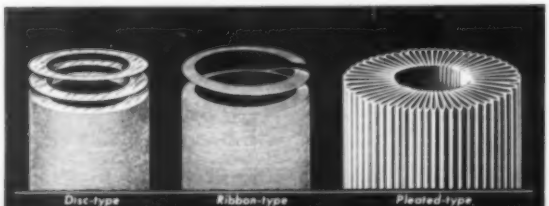

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AVIATION CORPORATION

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ORIGINATOR OF **MICRONIC** FILTRATION

method of installing cup packings that overcomes previous installation problems. Conical springs, exerting a comparatively light pressure, allow the packings to expand and contract with pressure conditions. The spring mounting technique allows the free valving action necessary for perfect sealing. It also reduces assembly time and skill required of production personnel or field service men.

Spring mounting is particularly applicable to flexible, resilient cup packings. Tests were made on a pre-formed cup made of leather but thoroughly impregnated with synthetic rubber to impart the best characteristics of both materials. The cup design has an almost square corner with the side wall molded on a slight flare. The new cup was designed to increase packing life and sealing efficiency.

Spring pressure varies with the size of the packing. When compressed approximately 75 percent of their free length, the following pressures have proven sufficient:

For cups with 1" OD—15 pounds total spring pressure
" " " 3" OD—35 " " " "
" " " 4" OD—50 " " " "
" " " 6" OD—75 " " " "

Conical springs are recommended.

The slight initial loading on the bottom of the cup will hold it in place and prevent leakage at zero pressure. As the pressure is increased, the force against the inside follower plate and the bottom of the cup is in direct proportion to the actuating pressure. The heel diameter will expand under pressure due to bottom compression and, at zero pressure, it is free to return to its molded size. Cups so mounted have approximately half the friction characteristics and almost twice the life of conventionally mounted cups. ▼▼▼

Data for the light spring loading of cup packings was furnished by the Hydraulic Engineering Staff of E. F. Houghton & Co.

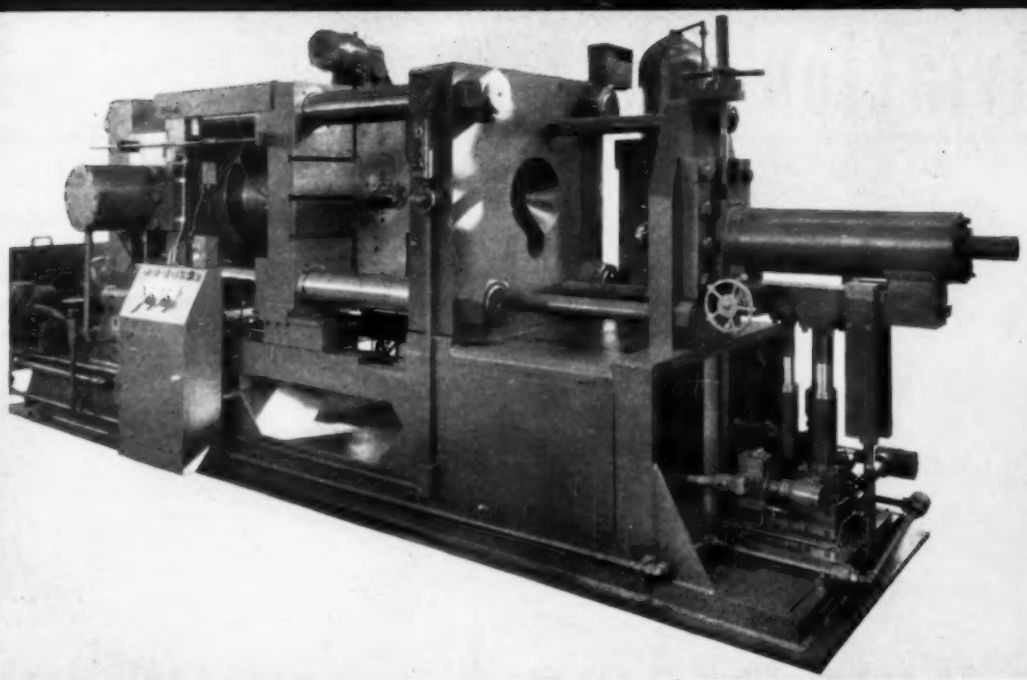
WELDER CIRCUITS

Concluded from page 132

has stopped, pressures are equalized through the common valve. Since there is now no motion, differences in friction are of no significance.

Air is supplied through a rotating inlet in the bottom of the turntable bearing shaft. Electrical power for solenoid valves is connected through collector rings. The welding head is mounted on a vertical slide above the welding point.

Importance of pneumatics in the successful operation of this machine is evident in the design and construction of relatively simple mechanisms. In comparison, a system of cams and linkages would have been both costly and time consuming to build. A great degree of flexibility is possible with solenoid control for air cylinders. The forces can be varied by regulating pressure, the speed of operation can be adjusted with flow control valves, and the delay between critical portions of the cycle can be controlled by timers. The whole sequence of operation can be easily changed if necessary. ▼▼▼



Wedgelock for sound, usable castings. Wedgelock machines attain and hold high pressures to produce denser castings, reduce maintenance and down time and give long, trouble-free service to the user. Exclusive "Wedgelock" design enables operator to hold up to 40,000-lb. pressures in shot plunger without resultant flashing of metal. No toggle links to break. Easy to operate.

for performance, economy, safety . . .

fire-resistant Pydraul fluid in Wedgelock machines

When you team up fire-resistant Pydraul hydraulic fluid with Wedgelock die-casting machines, you benefit two ways. First, trouble-free operation. Pydraul is noncorrosive and doesn't tend to form sludge. Second, with fire-resistant Pydraul, your hydraulic system is safe from the danger of hydraulic fire always present when flammable fluids are used.

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If your hydraulic equipment is near hot metal, electrical contacts, open flame or other heat sources, you're taking a needless fire risk. Your Monsanto representative will show you how easy and economical it is to convert to a fire-safe Pydraul system.

Write for FREE Pydraul F-9 booklet. Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. OEM-5, St. Louis 1, Mo.

Pydraul F-9—first and only hydraulic fluid listed by Underwriters' Laboratories

"In respect to fire hazard, Pydraul F-9 is rated by Underwriters' Laboratories, Inc., 2 to 3 in a class much less flammable than paraffin (petroleum) oil, according to a schedule in which Ether is rated 100; Gasoline 90—100; Alcohol (ethyl) 60—70; Kerosene, 30—40; Paraffin Oil, 10—20." *Pydraul: Reg. U. S. Pat. Off.*

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VALVE DESIGN ... for high pressure and delivery

To control a flow of 10 gpm at 4000 psi, this solenoid-controlled, pilot-operated design uses a special piston assembly which results in a small, lightweight unit.

• By John A. Lankester
European Editor, APPLIED HYDRAULICS

WITH the use of 4000-psi aircraft hydraulic systems becoming more widespread, there have been increasing requirements for more efficient directional valves to control the high pressure and high rates of flow. The objective of designers has been to provide accurate directional control instantly at the touch of a button. In many installations the introduction of higher pressures led to the reduction of cylinder sizes and pipe diameters, so that comparatively low delivery systems were adequate until recently. However, stepped-up power requirements are now requiring increased sizes.

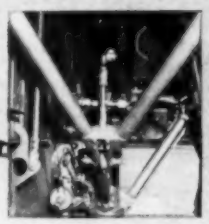
To take care of both the higher pressures and higher rates of flow, a solenoid-controlled, pilot operated valve called "Hydel" has been designed by Dowty Equipment Ltd. The valve can easily handle rates as high as 10 gpm at pressures of 4000 psi. At some sacrifice in the form of increased pressure drop, deliveries as high as 20 gpm can be controlled. A test pressure of 6000 psi ensures ample safety margin. At 10 gpm the loss through the pressure-to-service port is only 34 psi, and in the service-to-return port the loss is about 90 psi. The temperature range of the valve is from —65 to +158 degrees F.

OPERATION

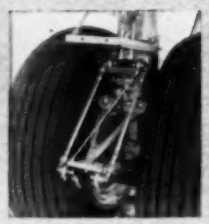
The principle of this design is that two solenoids actuate ball type valves which act as pilot valves to move pistons. These pistons shift the slide valve valve into the desired position. This pilot operation of the main slide valve is not new, and it is frequently used for the operation of large industrial valves, but in this case the pilot action is contained within a single, small unit. This simplifies the pip-

LOCKHEED ELIMINATES TIGHT BEND RADII

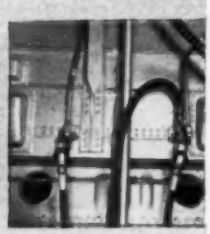
WITH CHIKSAN SWIVEL JOINTS



Installed on the nose wheel assembly of the P2V-7, Chiksan Swivel Joints eliminate tight radii bend in rubber hose.



Chiksan Swivel Joints on landing gear of Lockheed's Constellations give metal hydraulic lines the flexibility of rubber.



Located in the landing gear housing of the C-130 these Chiksan Swivel Joints conserve system space, lengthen hose life.

"Better check with Chiksan." That phrase is almost a byword with Lockheed design engineers when the problem of tight bend radii develops. For good reason, too. Lockheed engineers have found time and again that Chiksan has the experience and the facilities to provide a compact lightweight swivel joint to meet their needs quickly, efficiently. Check with Chiksan. Remember that phrase the next time you want a fast, right answer to your bend radii problem.

CHIKSAN

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

FOR CATALOG WRITE DEPT. AH-10

CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

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ing and makes a light and compact installation which is an important consideration in aircraft practice.

Figure 3 shows details of the construction and functioning of the valve. In the neutral position, the pressure is directed to both of the inner and outer piston assemblies. Movement of these pistons and consequent displacement of the slide valve is accomplished by releasing pressure from one piston assembly allowing the opposing piston to move the main slide valve to the selected position. Energizing the left-hand solenoid opens the ball valve on the left releasing the pressure behind the left-hand piston assembly. This throws the slide valve out of hydraulic balance, and moves it to the left connecting the pressure port to the left service outlet. At the same time, the righthand service connection is opened to drain.

On de-energizing the left solenoid, the ball valve is re-seated and equal pressure is once more restored to both piston assemblies. Since the right outer piston is abutting against its retaining shoulder, it imparts no thrust to the slide valve and is inoperative so far as the centralizing of the slide is concerned. Therefore, the combined area of the inner and outer left-hand pistons is greater than that of the inner piston alone opposing them on the right. The main slide valve being subjected to an out-of-balance load is therefore moved into the neutral position. When the reverse selector button is pressed, the right-hand solenoid is energized and the flow through the valve is reversed diverting the pressure out through the right-hand service outlet. Positive movement of the slide is achieved without any tendency to oscillate or hunt.

An indication of the snap action of this design is illustrated by the time required for operation. The slide valve requires .03 seconds to move to neutral from an operated position and .12 seconds to move from neutral to an operated position.

Another interesting feature of this design is the ease with which ground testing and emergency operations can be performed. The armature of each solenoid projects through the end of its windings and is enclosed by a rubber cap. The pilot valves

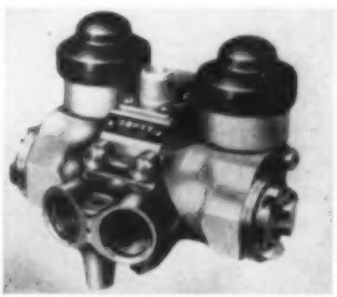


FIG. 1. VALVE WEIGHS 2½ lb and fits into space 4 x 4 x 5 inches.

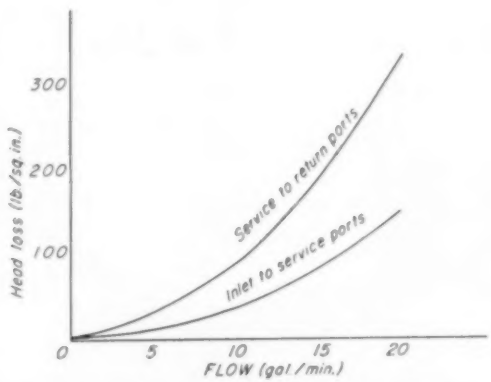


FIG. 2. PRESSURE DROP as a function of flow. At a flow of 10 gpm, pressure drop is 34 psi in pressure-to-service port and 90 psi in service-to-return port.

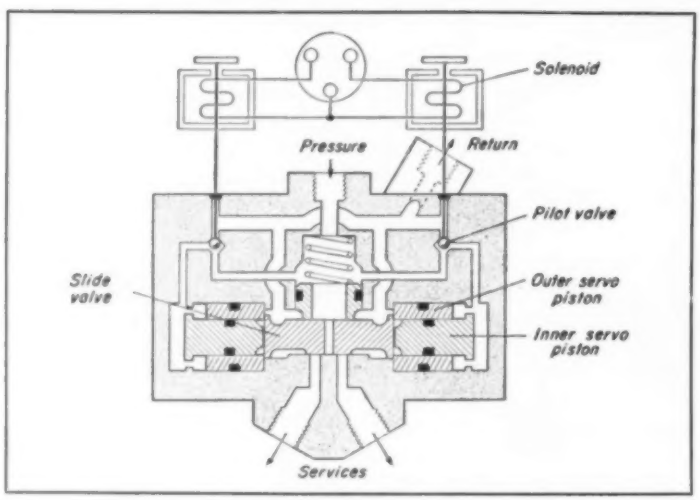


FIG. 3. DIAGRAM OF VALVE shows piston assemblies consisting of inner and outer pistons. Sealing is accomplished with O-rings and lapped surfaces. Spring maintains force between thimble and slide valve.

may be manually operated by pressing the flexible caps covering the ends of the solenoids. This opens the corresponding ball valve and makes the desired selection. This manual actuation can be a valuable emergency safeguard in the event of an electrical failure.

SEALING

The pistons are sealed with O-rings. The other points at which leakproof sealing is required are between the slide valve and the connector block beneath it, and between the slide valve and the spring-loaded thimble above it. Sealing at these points is achieved by lapping the slide valve to the connector block and also to the spring-loaded thimble. The thimble is sealed around its periphery by an O-ring. The use of a spring-loaded thimble for sealing above the slide valve ensures ease of assembly in manufacture, and eliminates the very high precision dimensions and fitting that would otherwise be necessary to prevent leakage above and below the slide. The thimble is shaped to make the pressure acting on the larger area of its top surface force it down onto the slide and maintain intimate contact with the slide. The greater the pressure which the valve has to retain, the greater the force holding the lapped surfaces of the slide valve assembly in leakproof contact.

The valve body is machined from an aluminum alloy forging and is threaded for the pressure and outlet pipe connections. The slide valve and thimble are made from precision castings of nitrogen hardened steel. The connector block on which the valve slides is made from an aluminum alloy forging, thick-annodized about .003 inch on its contact face, and is lapped to the slide valve.

ADDITIONAL DESIGNS

The valve can be adapted for many different purposes, and a wide variety of types are all based on the same operating principle and use the same component parts. A minor modification to the slide valve produces an open-center valve as shown in Figure 4. Another variation with no neutral setting is shown in Figure 5. In this case one solenoid is eliminated and the remaining one is arranged to release pressure from only one piston. The pistons have different areas and the smaller one is permanently connected to the pressure port. The differential area arrangement allows the slide valve to be moved and held in either selected position, but not in neutral.

Another design shown in Figure 6 employs a slightly modified slide valve which can couple the service connection either to pressure or return with no intermediate settings.

This wide choice of models makes it easy for the designer of a hydraulic circuit to specify the exact valve required for numerous different duties and at the same time simplifies production. ▼▼▼

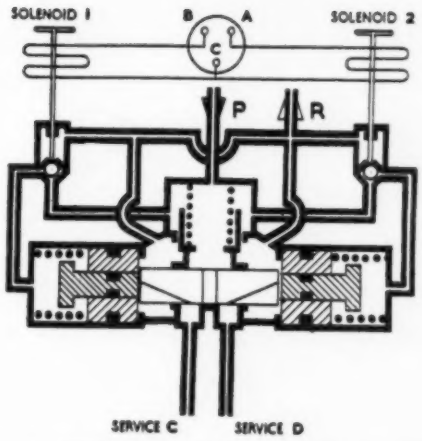


FIG. 4. THREE-POSITION, open-center arrangement. In neutral position pressure port is blocked and service ports are connected to return.

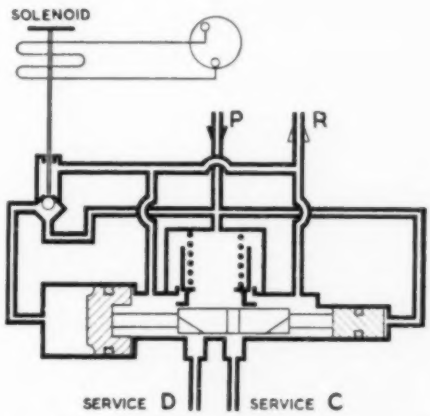


FIG. 5. SINGLE SOLENOID, 2-way valve. In deactuated position, service port D is connected to return, and service port C and pressure ports are blocked. Pressure is maintained on smaller piston. Ball valve controls pressure on large piston.

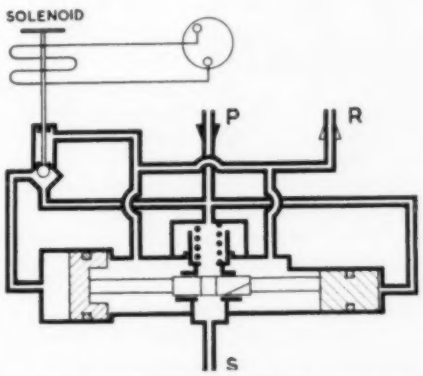
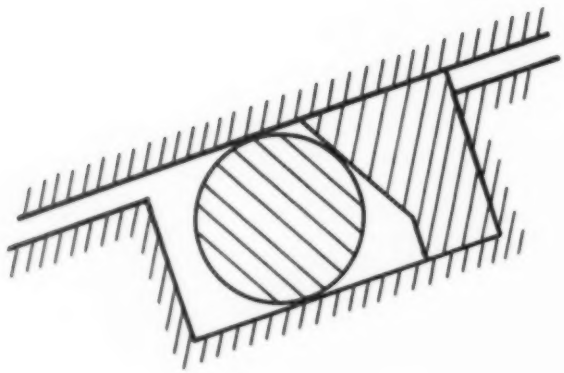


FIG. 6. TWO-WAY ARRANGEMENT connects service port to pressure in actuated position and to return in deactuated position.



Operational tests in a Scorpion F-89D using the delta backup ring for piston seals exceeded 630,000 cycles without leakage or maintenance. The new design supports the O-ring better, reduces friction, and minimizes distortion.

DELTA BACKUP RING

... for dynamic sealing

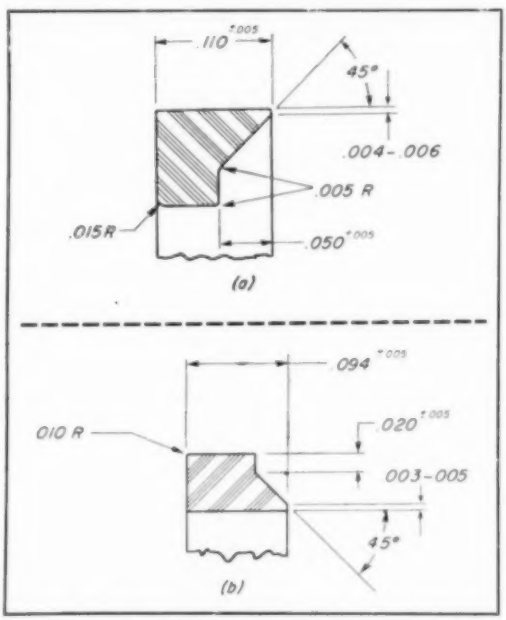
ONE of the problems in providing highly reliable aircraft is in seal design for hydraulic cylinder pistons. O-rings together with a spiral backup ring is the common design. However in high-cycle applications the O-ring is eroded by friction in a comparatively short time.

A new backup ring design with a cross-section in the shape of a modified delta has been developed by engineers at Northrop Aircraft, Inc. to increase the life of O-ring seals. Because of the shape of this backup ring it more completely supports the O-ring and reduces friction. Consequently there is less distortion and wear of the O-ring providing a longer life. Grooves for the installation are standard.

The first laboratory tests with the new design were very promising with the O-rings withstanding 2 million cycles. Tests have been carried out at 3000 psi and 300 degrees F. Later operational tests in a USAF Scorpion F-89D exceeded 630,000 cycles without leakage or need of maintenance, and the rings are still in use. This design has been shared with other manufacturers where laboratory tests have confirmed that the new backup ring is capable of withstanding cycling far in excess of that obtained with present standard designs.

An addition to the original design is the use of a tandem combination in which a pressure seal is installed ahead of the external O-ring seal. The first seal absorbs high pressure and friction loads allowing a small controlled amount of leakage. This low pressure leakage is then retained by the O-ring and returned to the system reservoir. This design is expected to provide even greater seal life and reduce external oil leakage to a point just sufficient to maintain adequate lubrication for the hydraulic piston. The increased seal life should also greatly decrease field maintenance.

▼▼▼



CROSS SECTIONAL DIMENSIONS of modified delta backup rings. Dimensions shown in (a) are for use with AN6227-10 O-ring as a piston seal. Dimensions shown in (b) are for use with AN6227-7 O-ring as a rod seal. Backup rings are made from Teflon.

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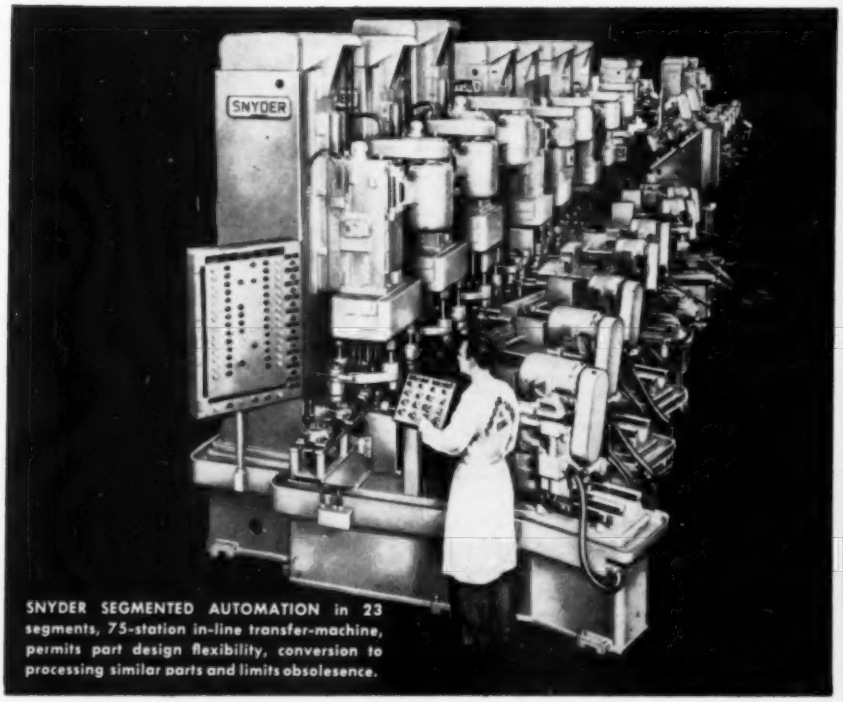

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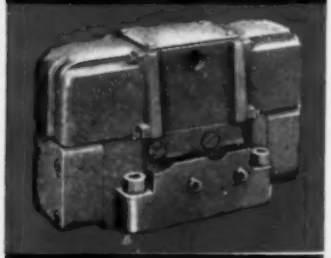

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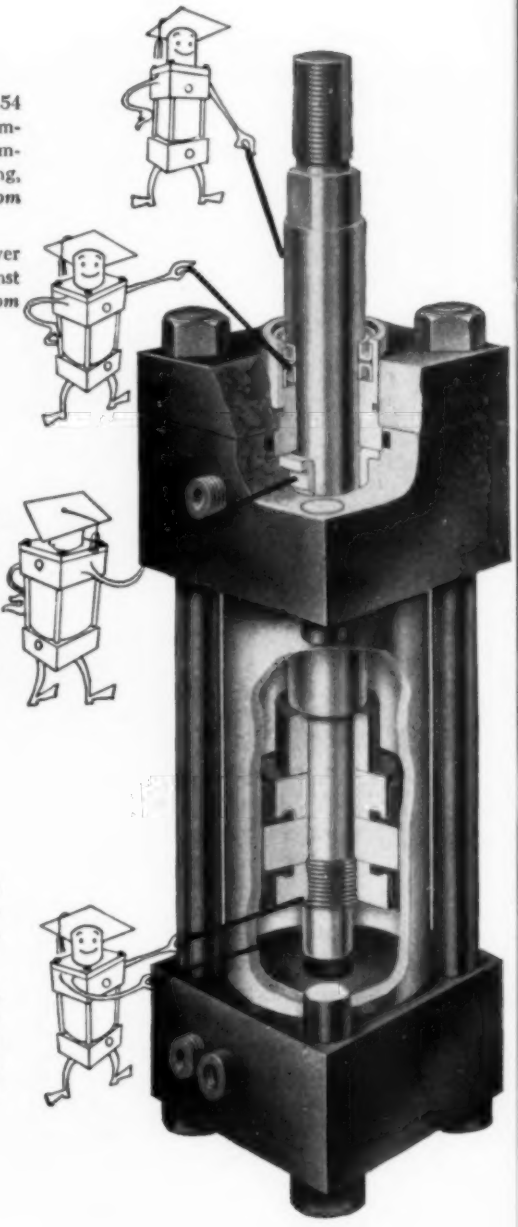

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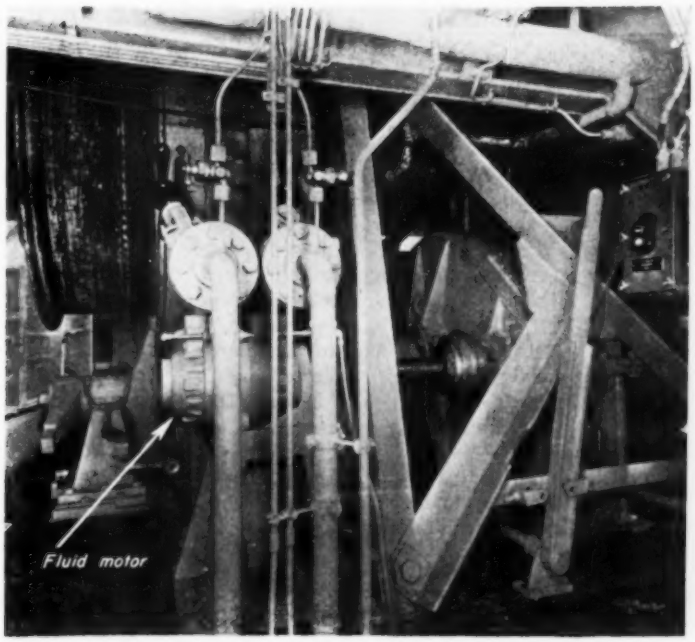

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Prime power for the cable laying machinery is supplied by two diesel engines, each connected to a hydraulic pump unit which drives hydraulic motors connected directly to the main shafts of the winches.

The pumping units are made up of two pumps on a common shaft, driven parallel by each engine from a gear box. The pumps are vane type, positive displacement, with a total capacity of 120 gpm at 1200 rpm. They are designed to operate against a pressure of 2000 psi, but the winches never demand this much pressure and the drive unit will supply the rated 120 gpm against a working pressure of 1400 psi.

The pumps are self lubricated from the hydraulic oil, and in each circuit there is an electric-motor-driven centrifugal pump which supplies oil to the system. To assure this supply of oil, a pressure switch is connected to the booster pump discharge. This acuates a solenoid valve in the diesel engine fuel line which prevents the engine from being started until the booster pumps are supplying oil to the circuit. Also, it causes the engine to stop if the booster system fails.

The pressure switch is set to actuate the solenoid at pressures above 20 psi. A relief valve is incor-

OIL DRIVEN WINCHES

porated in the booster pump discharge to maintain maximum booster pressure at 64 psi.

A 10-gallon hydraulic accumulator is used in the discharge line from the motor control valve. This is to add flexibility to the circuit when the ship is laying cable. As the vessel might raise up and down with the sea the stored energy in the accumulator will take up the slack to prevent shock loads. The accumulator is charged with nitrogen at 800 psi when there is no hydraulic pressure in the system.

On the control panel, in addition to the control valves, is a diesel engine speed indicator and a hand lever to control engine speed between 800 and 1200 rpm. Speed requirements vary with cable laying operations.

To utilize maximum torque when pulling a buried cable loose, or to break a jammed cable, the firemain, and the required flow of water is controlled by a thermostat in the oil line between the both hydraulic units may be coupled to one drum. This double power connection is accomplished through shifting gears on the winch. And when conditions require one diesel unit to power the opposite circuit, it can be accomplished through valve control.

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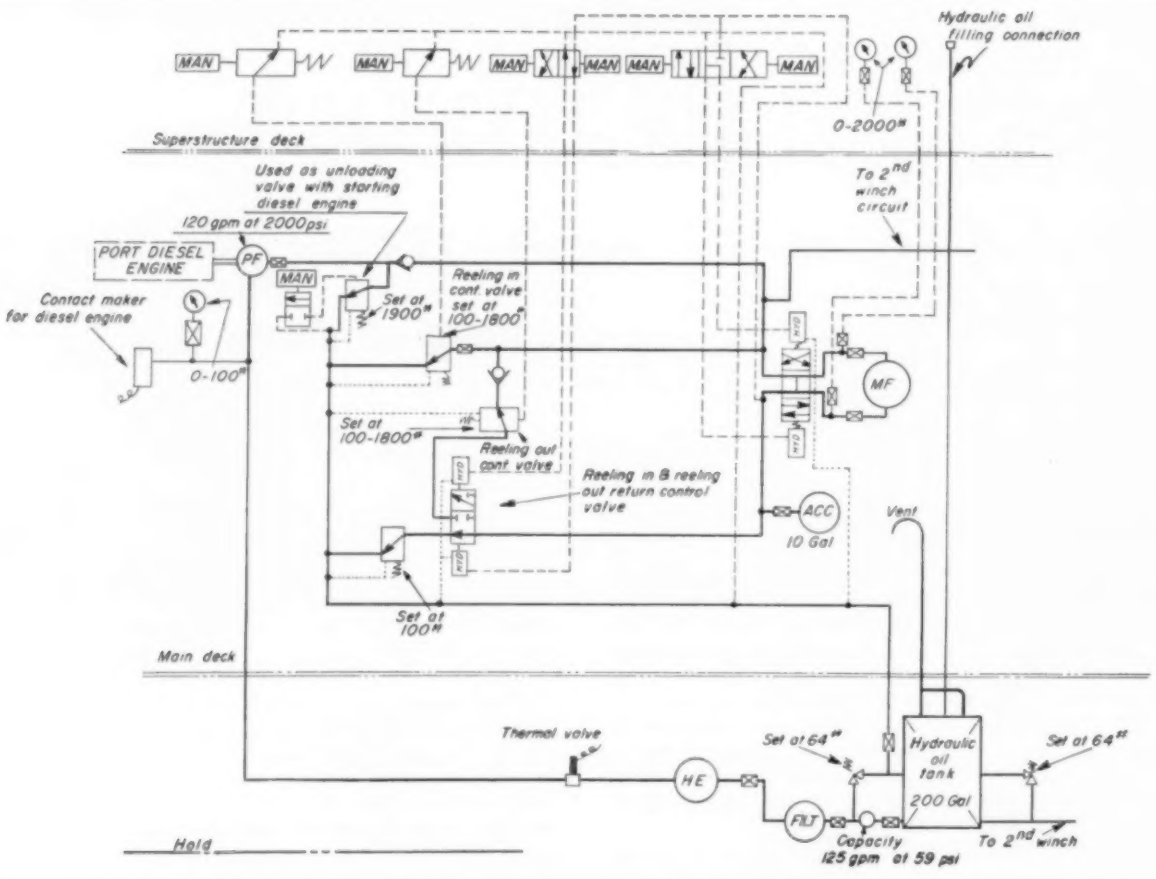
There is a heat exchanger in the circuit to maintain suction oil temperature at about 127° F. Cooling water for the heat exchanger is supplied from exchanger and the main pump. ▼▼▼



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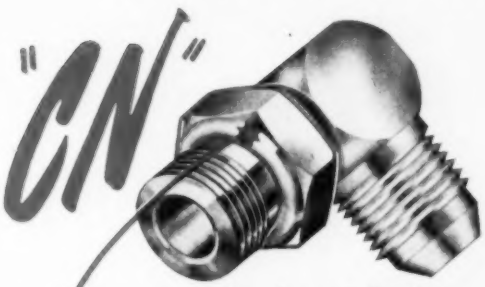

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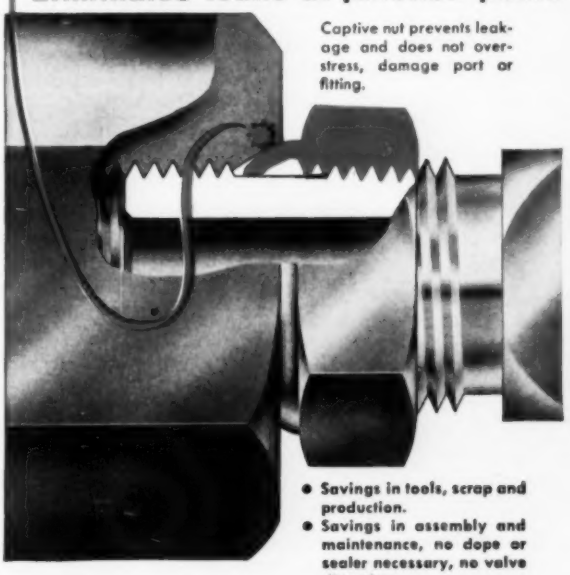

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Elmer F. Heiser

Elmer Heiser has been selling air and hydraulic components for 19 years. During this time he has solved many problems and admits to leaving some unsolved. He is the author of the book "Air and Oil Cylinders in Industrial Applications."

Summer Hydraulics

YOU may have missed this column last month. It was vacation time and it seemed in order to give you a complete rest while I went fishing.

Vacation started with the idea of going fishing but it became more of a hunting trip. Until the very last day, I was still hunting for the fish. This year it seemed that women, children and inebriates caught the fish while the hunters could only stand around and cluck in dismay. The fish I have left behind over the years should by now have fattened themselves out of swimming space.

What fluid power problems does one meet on a fishing vacation? One hydraulic problem involved a dish washing machine in the kitchen of the main lodge. One evening I heard miserable intermittent noises coming from the kitchen and through the window saw the camp owner fumbling with some tools, a flash light and a disturbed countenance. The noise was a mechanical sort of thing, out of place among the usual night sounds of breezes through the pine trees, hooting of owls and love calls of lovers, whip-or-wills, frogs and other inhabitants, so I barged in to offer assistance.

The dish washing machine was acting up and could not be used. Among its accessories it had a motor driven centrifugal pump which pulled water from a basin below some screens and directed it through a whirling sprinkler head to rinse the dishes. When we started the machine it would run quietly and orderly for a few seconds until the pump started tossing water through the nozzles and a growling sure-to-crack-up noise would let go. I started and stopped it several times in an effort to establish the source of the noise and by so doing attracted another passer-by. By chance, he happened to be supervisor of production in a large plant where they had a great many pumps in operation.

It was strange how a discordant mechanical sound in the north country could attract to the scene of trouble two capable and experienced trouble shooters. Working together, we analyzed the complete function of the dish-washing machine while the owner stood admiringly by. With our combined background, long experience and understanding we pin-pointed the

Circle 20 →

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✓	CARRINGTON	N. WEST, MERSEYSIDE & N. WA.	J. BROWN
✓	CLARENCE DOCK	N. WEST, MERSEYSIDE & N. WA.	BABCOCK & WILCOX
✓	CLYDE'S MILL	SOUTH WEST SCOTLAND	YARROW
✓	CONNAHS QUAY	N. WEST, MERSEYSIDE & N. WA.	INTERNATIONAL COMBUSTION
✓	COWES H. P.	SOUTHERN	DANIEL ADAMSON
	DONCASTER 'B'	YORKSHIRE	MITCHELL
✓	DRAKELOW 'A'	E. MIDLANDS/MIDLANDS	INTERNATIONAL COMBUSTION
✓	FLEETWOOD	N. WEST, MERSEYSIDE & N. WA.	SIMON-CARVES & R. WESTGARTH
✓	GOLDINGTON	EASTERN	CLARKE CHAPMAN

IN BRITISH STEAM GENERATING PLANT COMMISSIONED IN 1955
(LIST REPRODUCED BY COURTESY OF 'ENGINEERING & BOILER HOUSE REVIEW')

26 OUT OF **32** HAVE **Lockheed** REGD. TRADE MARK

HYDRAULIC REMOTE CONTROLS ON THE BOILER PLANT

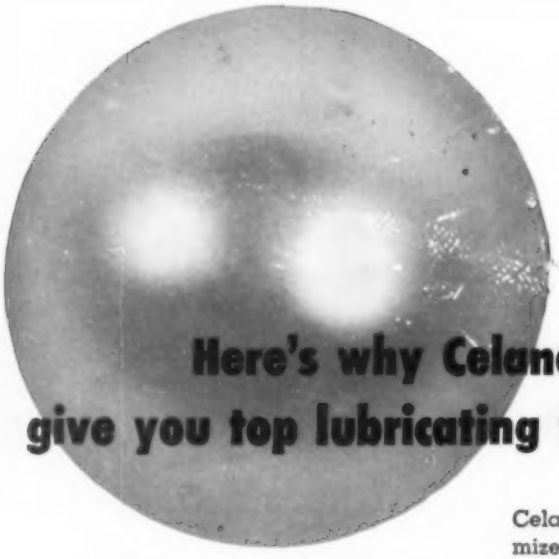
✓	HACKNEY 'B'	LONDON	SIMON-CARVES
	HUDDERSFIELD	YORKSHIRE	BENNIS
✓	HUNCOAT	N. WEST, MERSEYSIDE & N. WA.	———
✓	INCE	N. WEST, MERSEYSIDE & N. WA.	INTERNATIONAL COMBUSTION
	KEADBY	YORKSHIRE	STIRLING BOILER CO./B. & W.
✓	LITTLEBROOK 'C'	SOUTH EASTERN	INTERNATIONAL COMBUSTION
✓	MARCHWOOD	SOUTHERN	J. THOMPSON
✓	MEAFORD 'B'	MIDLANDS	BABCOCK & WILCOX
✓	PORTISHEAD 'B'	SOUTH WESTERN	MITCHELL
	SKELTON GRANGE 'A'	YORKSHIRE	INTERNATIONAL COMBUSTION
✓	STAYTHORPE 'A'	EAST MIDLANDS	BABCOCK & WILCOX
✓	STELLA NORTH	NORTH EASTERN	CLARKE CHAPMAN
✓	STELLA SOUTH	NORTH EASTERN	CLARKE CHAPMAN
✓	USKMOUTH 'A'	SOUTH WALES	BABCOCK & WILCOX
	WAKEFIELD 'B'	YORKSHIRE	FOSTER WHEELER
✓	WOOLWICH	LONDON	J. THOMPSON

Lockheed

REGD. TRADE MARK

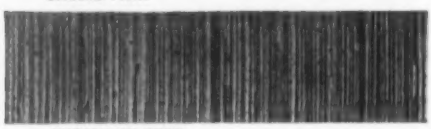
INDUSTRIAL HYDRAULICS

AUTOMOTIVE PRODUCTS COMPANY LTD., SHAW ROAD, SPEKE, LIVERPOOL, 19, ENGLAND



Here's why Celanese fire-resistant CELLULUBES give you top lubricating features

UNUSED PATH



PHOSPHATE ESTER

PETROLEUM OIL

PHOSPHATE ESTER BASE

WATER-GLYCOL BASE

Photomicrographs of the surface of ball path of bearing operated in four hydraulic fluids: petroleum oil, phosphate ester, phosphate ester base, and water-glycol base. Fluids were evaluated on a transfer test machine where angular contact bearings were operated to point of failure. Of the combustion resistant fluids tested, the straight phosphate ester gave the longest bearing modal life and the related ball path showed the least number of microscopic pits.[1]

Celanese Cellulubes are phosphate ester fluids designed to minimize the hazard of flash fires and explosions inherent in many industrial operations.

CONTAIN NO ADDITIVES

Because they contain no additives, Cellulubes give you excellent lubricating qualities, in addition to built-in fire-resistance. Just check these basic advantages offered by Cellulubes:

- **FIRE RESISTANCE —extremely high auto ignition point (over 1100° F.)**
- **LUBRICITY —excellent; low wear factor**
- **GRADED VISCOSITY —range of 6 controlled viscosities—90, 150, 220, 300, 500, and 1000 (S. U. S. @ 100° F.)**
- **STABILITY —unaffected by heat, wear or oxidants**
- **NON-CORROSIVE —in ferrous or non-ferrous systems**
- **NON-FOAMING —contain no additives; resist hydrolysis**
- **LONG-LIFE —chemically and physically stable**
- **MINIMUM MAINTENANCE —no viscosity adjustment required**

As air cylinder lubricants in compressed air systems, Cellulubes prevent the formation of excessive carbon deposits—the major cause of compressor fires. As hydraulic fluids, they reduce the danger of fires due to line breaks or other failures.

If you would like to evaluate Cellulubes in your own operation, use coupon below to order working samples and complete use data.

[1] From a report in *Lubrication Engineering*, July-Aug., 1956, entitled **"A Study of Combustion Resistant Hydraulic Fluids as Ball Bearing Lubricants,"** by H. V. Cordiano, E. P. Cochran, Jr., and R. J. Wolfe.

Reprints of this article are available from Celanese Chemical Division on request.

EXPORT SALES: Amcel Company, Inc. and Pan Amcel Company, Inc., 180 Madison Avenue, New York 16, N. Y.

Celanese Corporation of America, Chemical Division, Dept. 588-J
180 Madison Avenue, New York 16, N. Y.

Please send me working sample and technical bulletin on Cellulube for air compressor service ☐ for hydraulic systems ☐ Send technical representative ☐

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COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

Celanese CHEMICALS

Cellulube® Celanese®

Ideas from A Sales Engineer

Continued

trouble in jig time. The pump impellor was overhung on an extended motor shaft; the front bearing had never been oiled; wear in the bearing allowed the impeller to sag and rub on the housing when under load, displacing water. Simple?

Although replacing the bushing would have been just as simple as the diagnosis we decided against making the repair for our grateful host. We didn't have a new bushing nor did we have a shaft seal or the flange gaskets which would also have to be replaced. We, therefore, recommended that the entire machine be taken to the nearest dealer, 120 miles away. Obligingly we helped disconnect piping and wiring and ripped the unit from its built-in moorings so that early next morning it could start on its trip.

The next evening when the owner returned from his all-day trip, he thanked us too graciously for our help and added "You really wanna know what was wrong? There were a couple of plum pits, some tooth picks, bobby pins and a small bone or two which got past the screen and into the pump."

Well, I went there to fish and sorta suspected all the time that the other chap who claimed he knew all about pumps was fanning the breeze.

Boy Civil Engineer

Another fluid power problem presented itself but except for some further unsolicited help, I did very well this time. In order to provide a safe mooring for our boat away from the flat bottom jobs tied helter-skelter at the regular dock, I cleared a dead end space channel into the main body of water. It was easy to scrape through a short partially damming wall of sand and clay to float the boat into an otherwise unreachable spot where I built a dock. With the boat tied fore and aft to the dock I scraped out a hole under the outboard motor sufficiently deep to run the motor. By running the motor at a good speed a flow of turbulent water

Circle 122 on Reader Service Card

Locate the trouble quickly — easily in your hydraulic system

Schroeder Portable Hydraulic Circuit Tester

The new Schroeder Hydraulic Circuit Tester speedily checks the operating efficiency of your hydraulic circuit components.

Weighing only 19 pounds it is housed in a convenient, sturdy carrying case, size 7" x 11" x 8¾" and can be carried without effort to the machine location. After the proper connections are simply made, by rubber hose, the tester simultaneously measures the temperature, pressure and flow from the component port under test. The unit has a pressure range of 300 to 2000 PSI and a maximum flow of 50 GPM.

Check out your hydraulic system's operation—order a Schroeder Portable Hydraulic Circuit Tester today — literature and prices on request.

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CORPORATION
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THE NEW AUTO-DIESEL GAPLESS PISTON RINGS for SEALING PNEUMATIC HYDRAULIC CYLINDERS

The Auto-Diesel GAPLESS Piston Ring involves a new principle in ring construction and offers advantages not found in any other ring. Notice the patented insert—it offers 3 advantages. (1) Reduces air or oil leakage. (2) Lowers the cost of compressed air. (3) You get a more positive stroke. It can be adapted for high temperatures by changing the insert. It can be made a contracting ring for sealing shafts, bearings or replacing packings, etc., and many other applications.

Pat. No. 2,738,243

NO MORE BLOW BYS

The insert is what prevents blow bys because it makes a POSITIVE SEAL. It can be used as original or replacement in pneumatic operated industrial equipment and for normal pressure hydraulic. Made in sizes from 2" and up. You are assured longer life and greater compression.

Write for Details

THE AUTO-DIESEL PISTON RING CO.
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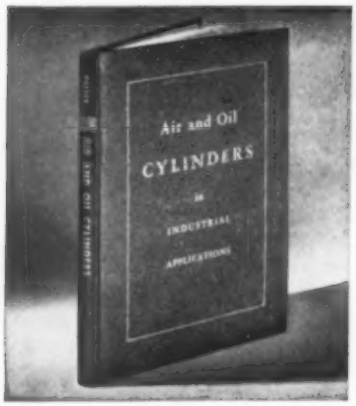
"RINGS and SHAPES Since 1921"

Circle 17 on Reader Service Card

AIR & OIL CYLINDERS



Elmer Heiser has written this valuable cylinder handbook which tells about types, cushions, how to order, proper porting, correct sizing, packings, and efficient installation methods.—**It's full of application ideas.**

PRICE $5.00

The Industrial Publishing Group

812 Huron Road • Cleveland 15, Ohio

IDEAS FROM A SALES ENGINEER

Continued

kicked out through the obstructing dam and flushed out sand, clay and debris to make a good channel back to the dock.

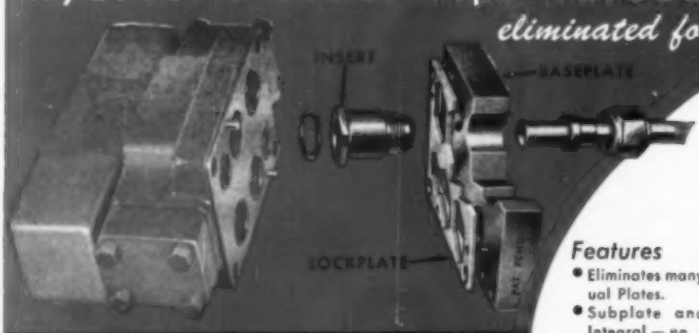
Everything was fine except that it required skillful navigating to get through the channel due to an old tree stump too large to flush via hydraulic flow. Now came the unsolicited help. An old timer, serving as a guide at the camp, offered to dynamite the stump. While the water was still burbling from the blast, we walked out on the dock to see the results. The previously satisfactory channel was now a maze of shredded roots, sand and clay. And, with five observers on it, the weakened dock collapsed into the channel. The dock was a shambles and the channel impassable.

The second dock went up much faster than the first, incorporating some construction features omitted in the original. Hydraulic flushing of the channel was again highly effective. After repeated passages the stump, which remained, proved no particular hazard in fact it was an interesting challenge and a test of skill. Negotiating the channel under varying wind and current conditions without leaving traces of bottom paint on the stump came to be regarded as an accomplishment.

A Scientific Study

Lest you conclude that the vacation was a total loss, let me tell you about cavitation observations. I found that it was impossible to create a cavitation or starvation condition with the outboard motor and hold it for any desired period of time while under way. By a stretch of imagination there is some similarity between a pump moving oil and an outboard propeller pushing a boat. In one, the pump stands still while the pump or propeller screws its way through. By starting slowly, cut-

Hydraulic Panel Pipe Thread Leaks
eliminated for you!



THREADLESS SUBPLATES FOR INDIVIDUAL VALVE MOUNTING

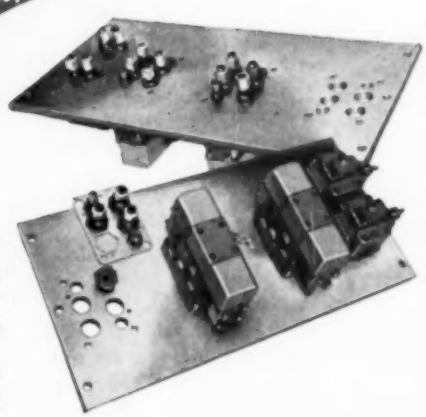
Features

- Tube Connections Integral with Inserts.
- Inserts for all Tube sizes.
- No Pipe Threads necessary.
- No Pipe Thread Leaks.
- No Fluid Passages through porous castings.
- No Porosity Leaks.
- Installation and Maintenance costs reduced.

Inserts
The Inserts are the only parts in the assembly subject to direct hydraulic pressure and they are machined from Open Hearth Steel Bars.

Lockplate
This is the metal plate that locks the Inserts against rotation. It also provides the valve mounting surface flush with the gasket sealing faces on the Inserts.

Baseplate
The Baseplate is made from cast gray iron and acts both as the valve mounting pad and the bracket to hold and position the Inserts.



Features

- Eliminates many Individual Plates.
- Subplate and Panel Integral — no separate mounting panel.
- Standard Inserts and Lockplates used.
- Base plate contains no pipe threads and is not subject to direct hydraulic pressure.

THREADLESS SUBPLATES FOR MULTIPLE VALVE MOUNTING

Insert — Standard part — same as used with individual mount-

Lockplate — Standard part to suit each valve to be mounted.

Baseplate — Hot rolled steel plate— Number and arrangement of valves to suit your application.

Applications—For all Gasket Mounted Valves

PETCH

Factory
Alpena, Michigan

PMC

ting into a sharp turn and gunning the motor, a cavitation condition could be started. On a sharp turn the propeller lifts toward the surface and as with hydraulic pumps in small reservoirs, it is easier to pull air from the surface than "bite" into the hydraulic fluid to do work.

Cavitation in clear water shows up as a twisting vortex of air running from the surface down to the prop. Even though started by the prop running shallow, the condition could be retained with the boat back on a straight course and the prop running at its usual depth. Cavitation or starvation caused the motor to speed up and run rough while the boat slowed and "mushed down" in the water. I could trail the air cone and toy with it as long as desired, then eliminate it by cutting back on the throttle. Advancing the throttle on a straight course would not cause a recurrence of the condition. Interesting?

If you ever have cavitation problems and want to see what goes on grab a tackle box and head for clear water. ▼▼▼

Circle 24 on Reader Service Card

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GREAT LAKES SALES
&
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WHitehall 4-5313
FOR 140 SIZES OF
OHIO "O" RINGS
STOCK SHIPMENTS SAME DAY YOUR ORDER IS RECEIVED; AIR SHIPMENTS DAILY! QUALITY O-RINGS MADE IN COSTLY CHROME PLATED MOLDS, PRECISION PROCESSED, ASSURE YOU THE FINEST O-RINGS YOU CAN BUY!
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OHIO "O" RING
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PETCH CYLINDERS
NC-1 Standard
Heavy Duty Air
200 psi
A rugged Air Cylinder to perform under your most severe operating conditions — Stamping Plants, Foundries, Welding Equipment Manufacturers and many others standardize on this Cylinder to cut maintenance costs.
5 Standard Mounts
PF—Foot Mount
PC—Clevis Mount
PT—Center Trunnion
PB—Blind End Flange
PR—Rod End Flange
Features
• Steel Heads
• Oversize Piston Rod
• Long, Filleted Rod Thread
• Double Ports, each Head
• Interchangeable Cushion Screw & Ball Check
• Full 5:1 Safety Factor at Rated Pressure
Original PETCH features . . .
• Cartridge Type—Rod Wiper, Seal and Bearing Group
• Floating Cushion Bushings assure reproduceable cushion action
• Interchangeable Mounting Parts
Note: Readers Reference Card for both Subplates and Cylinders—
MANUFACTURING COMPANY
463 York, DETROIT 2

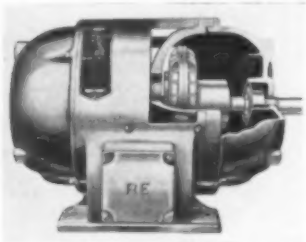
Circle 107 on Reader Service Card

New Products continued

ELECTRIC MOTOR
. . . incorporates coupling

Designation: Flexi-Shaft

Features: By mounting a shaft coupling inside the motor frame, the unit achieves smooth load acceleration, protection against equip-



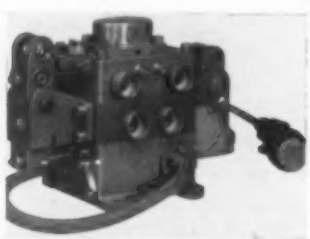
ment jamming, and ability to start heavy loads with lower, operating power. Dry fluid coupling is based on centrifugal force throwing steel shot to the perimeter of the housing. The housing is keyed to the load and accelerates as the rotor gradually becomes "imbedded" in the tightly packed shot. Combination units with magnetic brakes and gear reducers can be supplied to solve various drive problems.

Reuland Electric Co.
Alhambra, Calif.

Circle 169 on Reader Service Card

SERVO VALVE
. . . for aircraft surface control

Application: Valve combines artificial flight stability augmentation and the work of auto pilots with pilot boost servos. Valve permits direct mechanical-hydraulic flight



control, combined mechanical-hydraulic and electro-hydraulic control, and electro-hydraulic control alone.

Design: Valve has full mechanical override for safety. Self-contained solenoid and lock-out arrangements permit full flight mode selection. Servo valve employs new principle of summation whereby the electromechanical mixing is accomplished without linkage in a single, compact, integrally-designed package. By eliminating linkage inertia and backlash, the valve greatly increases low amplitude resolution and frequency response.

Moog Valve Co.
East Aurora, N. Y.

Circle 170 on Reader Service Card

MANUAL SHUT OFF VALVE
. . . for 3000 psi

Design: Valve has hand wheel with position indicator for opening and closing in a 90-degree turn, and may also be supplied with conventional handle. Provisions for panel

mounting are standard. Valve uses shear-seal principle and has a pressure balanced, self-aligning tubular sealing ring which is in constant contact with an optically flat porting disc or rotor containing the flow passage. Flow is through sealing passage and not across sealing surfaces.

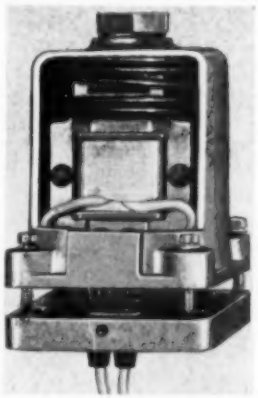
Specifications: Valve is rated for 3000-psi oil and 2000-psi air, and is available in port sizes of ¼, ⅜, ½, ¾, and 1-inch NPT. Valve can withstand velocities to 60 ft/sec without modification.

Barksdale Valves
Los Angeles, Calif.

Circle 171 on Reader Service Card

SOLENOID
. . . is oil immersed

Design: Solenoid is oil immersed and individually sealed to avoid difficulties of contamination of the immersion oil by sludge and destructive foreign materials. Unit has specially designed die-cast case only slightly larger than a standard



model of same rating when enclosed in a dust tight cover.

Construction: Sealed unit is equipped with plug-in contacts and is installed as easily and quickly as a radio tube. Unit is securely anchored in working position by four captive bolts to reduce installation time. Sealed pin in case top permits manual operation of solenoid for machine set-up.

Performance: Built to JIC Specifications, solenoid is fully shock-mounted in two directions and operates 35 to 50 degrees cooler than standard models. Typical test solenoid showed no measurable wear after 8½ million strokes at 24 strokes per minute. Another test showed only superficial wear on the beating surfaces after 34 million strokes at 300 strokes per minute.

Detroit Coil Co.
Ferndale, Michigan

Circle 172 on Reader Service Card

FLEXIBLE PLASTIC TUBING
. . . is steel reinforced

Designation: Bardex

Construction: Tubing is clear plastic with special tensile spring embedded in its walls. Tubing will bend around a 5/16-inch spindle without distorting its internal bore.

Application: Tubing is recommended for applications where there is a tendency to tangle and kink. Flexibility also makes it suitable for connections between two movable parts. Light weight pro-

Continued on page 156

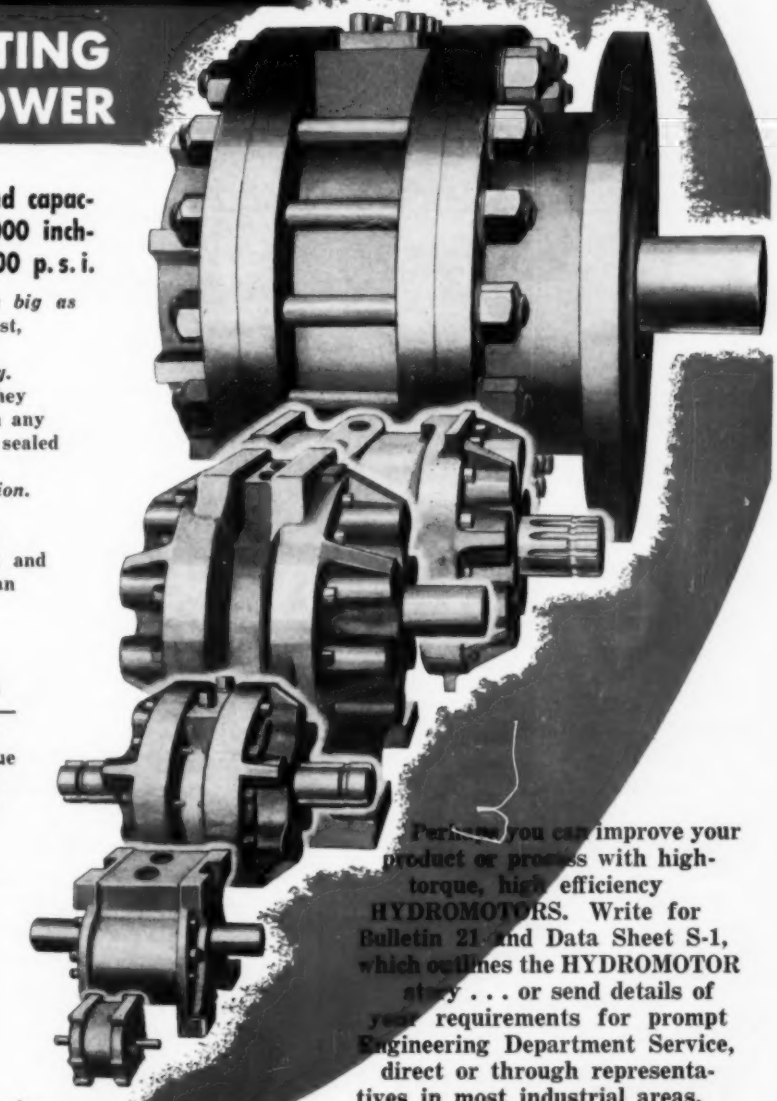
Automation with the *Hydromotor*

RECIPROCATING ROTARY POWER

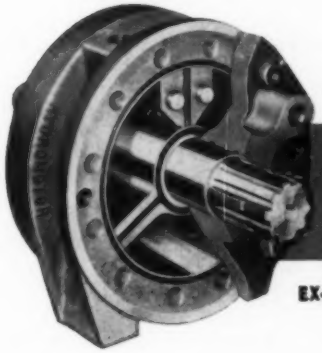
Wide choice of models and capacities from 150 to 1,000,000 inch-pounds of torque at 1000 p.s.i.

From the smallest *(only as big as your fist)* through the largest, HYDROMOTORS are *saving users time, space and money.* Compact and lightweight, they can be mounted anywhere, in any position and are completely sealed and self-contained to insure *dirt-free, trouble-free operation.* HYDROMOTORS eliminate expensive, bulky mechanical linkages, installation is fast and easy, maintenance is cut to an absolute minimum.

With HYDROMOTORS *reliable automation* can be achieved more simply. This reciprocating rotary actuator—operating with air, water or oil—develops instant full torque in either direction. Standard units travel 280° and develop 150 to 500,000 inch-pounds of torque. Double vane units—with maximum travel of 100°—approximately double the above torque values of the single vane unit IN THE SAME SIZE HOUSING. Special sizes are custom-built to individual specifications.



Perhaps you can improve your product or process with high-torque, high efficiency HYDROMOTORS. Write for Bulletin 21 and Data Sheet S-1, which outlines the HYDROMOTOR story . . . or send details of your requirements for prompt Engineering Department Service, direct or through representatives in most industrial areas.



Hydromotor DIVISION

EX-CELL-O CORPORATION • CANTON 2, OHIO

LOWERING • REVOLVING
LIFTING • PUSHING • PULLING
SWINGING • OPENING
CLOSING • CLAMPING • TURNING
INDEXING • OSCILLATING, ETC.

New Products continued

vides greater mobility. Tubing has a working temperature from 5 to 170 degrees F with working pressures ranging from 100 to 200 psi depending on the size. Tubing is available in most sizes from ⅛ to 1-inch ID.

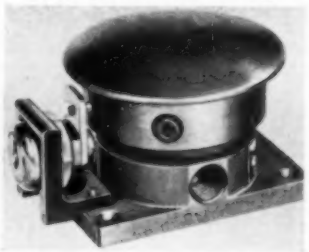
Newage International, Inc.
Jenkintown, Pa.
Circle 173 on Reader Service Card

PALM BUTTON VALVE ... for safety

Designation: 122 Series

Features: Valve has been designed specifically for circuits where safety is of prime importance and is suitable for all general applications which require a normally closed straight-way or 3-way, hand operated pilot valve. Valve can be provided with tumbler type lock permitting locking in either open or closed position.

Specifications: Although it is ¼ NPT side ported, overall height of

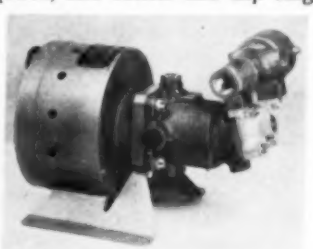


valve is only 2⅜ inch. The 3-way model has a non-piped exhaust and both straightway and 3-way have a ¼-inch diameter flow capacity. Because of low operating force and large diameter palm button, valve reduces operator fatigue.

Ross Operating Valve Co.
Detroit, Michigan
Circle 174 on Reader Service Card

ELECTRICAL GENERATOR ... for airborne use

Design: Unit consists of hydraulic motor and a-c generator to provide 400-cycle power for aircraft. Permanent-magnet type generator is 3-phase, 120/208 volts for 8000 rpm, and can be used at altitudes to 55,000 ft and ambient air temperatures from −65 to +250 degrees F. No voltage regulator is required, and exciter and slip rings



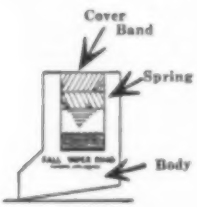
are eliminated. Constant speed motor is axial piston type. An integral flow control valve maintains the speed setting. Unit is rated for 3000 psi and has a high power-to-weight ratio with an overall efficiency of over 92%.

Specifications: Speed control is within ±2½% regardless of load. Special models maintain 400 cps within .1%. Units are available for .5 to 3 kva output. Weight of the individual units is from 7 lb for the smallest package to 19 lb for the 3 kva size.

Vickers, Inc.
Detroit, Mich.
Circle 175 on Reader Service Card

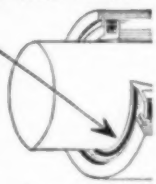
Fall —the original

SPRING LOADED
Wiper **Ring**
WITH SQUEEZE GRIP ACTION



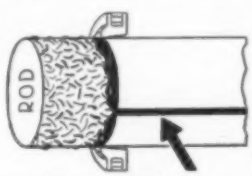
FWR-3C
3 Piece Type
Spec. Mil-S-5049, AN approved. Ring consists of 3 pieces assembled into one

Wiper Edge Is Tight Against the Rod at All times regardless of wear—



Cuts through Ice, Stops Build Up of Ice, Mud and other foreign bodies between rod and ring. You can depend on the FALL Wiper Ring because it IS Spring Loaded! Its spring maintains a squeeze grip action on the wiper edge of the ring at all times preventing ring from ever opening up. Rods never stick or become immobile in ANY temperature because uniform tension of spring is always the same under the endless cover band. Squeeze grip action is constant, uniform and complete around entire circumference of rod. The U. S. Army & Navy have used the 3 piece Fall Wiper Ring (FWR-3C) since 1944. Military part numbers from AN6231A1 ½" to AN6231A71 12" diameter.

Stop
This Dirt Streak at the Ring Joint with the "CJ" Closed Joint



Fall *Wiper* Ring SPRING LOADED

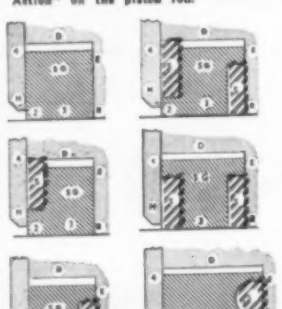
Fall Industrial Wiper Rings have a "closed joint" therefore contact the complete O.D. of piston rod and do a better job of "wiping" or "scraping" off ice, dirt, and other stubborn-to-remove-hardened-obstacles which adhere to rod. When needed, we add certain of our "rubber seal" features which, combined with metal ring, "seals out" dust and sand thus preventing passage around ring—and with another of our "rubber seal" features added "seals out" liquids thus preventing passage through ring.

Our engineers will gladly work with you on any wiper ring problem. Write, wire or phone us.

All FALL Wiper rings are covered by patents issued or patents pending.

ACE PRODUCTS CO. Toledo 1, Ohio. Phone CH3-4513
You Can Depend on ACE PRODUCTS
— Established 1935 —

Showing 6 of the many FALL "Closed Joint" Wiper Rings for Industrial Hydraulic and Air Use with "Squeeze Grip Action" on the piston rod.



RING DESCRIPTION
SG—"Squeeze Grip."
2—Front side of ring.
3—Closed joint is in ring.
4—Flange (or plate) holds ring in cavity.
5—Rubber seal compressed in restricted area.
H—Inside dia. of flange at bevel end (see #4 above).
D—Depth of Cavity for holding ring.
E—I.D. of cavity for holding ring.
R—Rings I.D. and/or rod O.D.

TEFLON FELT
. . . for seals, gaskets

Designation: Compound S-16810

Features: Kelon-T (Teflon) impregnated material withstands ambient temperatures from —320 to +550 degrees F. and has good resiliency. It is relatively soft and pliable with a low coefficient of friction, conforms to uneven flanges, and provides durable static or moving low pressure seals. Impregnated felt is available in thickness of 1/16, ⅛, and ¼ inch with special orders on request.

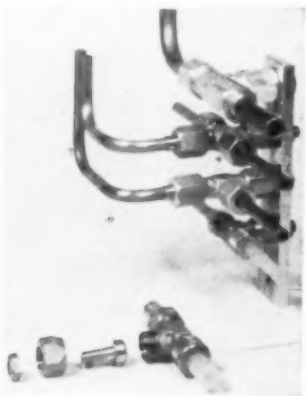
Shamban Engineering Co.
Culver City, Calif.

Circle 176 on Reader Service Card

MOUNTING STUD
. . . for tubing support

Designation: Intru-lok, Triple-lok

Application: Mounting stud or tube fitting anchor simplifies support of tubing lines. Intru-lok unit



is brass, flareless type tube fitting especially for instrumentation lines of either copper or plastic tubing. Triple-lok is flare type fitting, made in brass, aluminum, steel and stainless steel. Stud is used to mount a tee or cross fitting directly to a bracket or in a threaded boss. The mounting adapter represents a convenience particularly for lead-off locations in banks of tubes or "bundled" tubes.

Tube & Hose Fittings Div.
Parker Appliance Co.
Cleveland, Ohio

Circle 177 on Reader Service Card

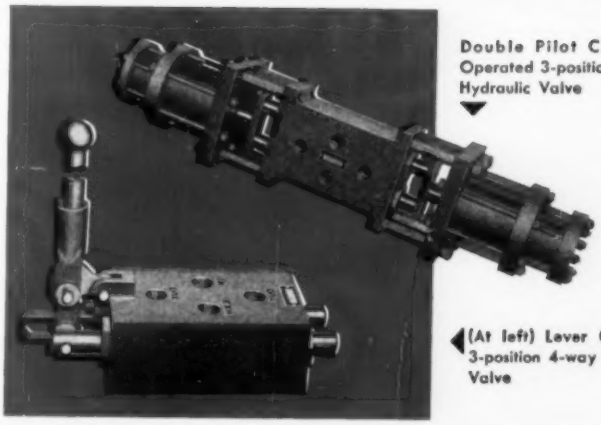
INTERVAL TIMER
. . . is multiple circuit

Designation: Model 73

Features: Timer is designed for low-cost application where a process is to be turned on manually,

Continued on next page

Quick-As-Wink® HYDRAULIC VALVES



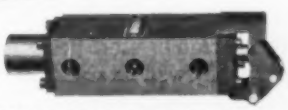
Double Pilot Cylinder Operated 3-position 4-way Hydraulic Valve

(At left) Lever Operated 3-position 4-way Hydraulic Valve

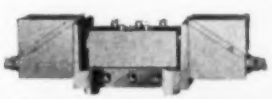
Hand and Pilot-operated Types for water or hydraulic oils to 5000 psi.

• These valves give users maximum efficiency, economy and dependability. Housings are milled from steel blocks or bronze forgings. The hollow, radially ported, stainless steel plungers are hard chrome plated and polished. Renewable metal valving rings assure long life of the packers which are expanded by internal pressure . . . the higher the pressure the tighter the seal. No metal to metal seating. The valves are fully balanced in any position. Inspection — and servicing if necessary — can be done easily *in the field,* avoiding the delays of returning valves to the factory for servicing, or the need to carry large inventories of standby valves — or even parts. Complete dimensions, capacities and other data sent promptly. Write for Bulletin No. 531,— Today!

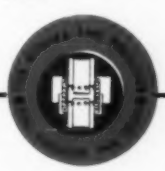
Ask us also about . . .



CAM OPERATED SINGLE PLUNGER VALVE ⅜" to ¾" sizes. Operated by rotating cam or land on reciprocating device.



DOUBLE SOLENOID "O-TYPE" VALVE for pressures up to 125 psi. Widely used as pilot valves and for operating air cylinders.



Quick-As-Wink®
AIR AND HYDRAULIC
Control Valves

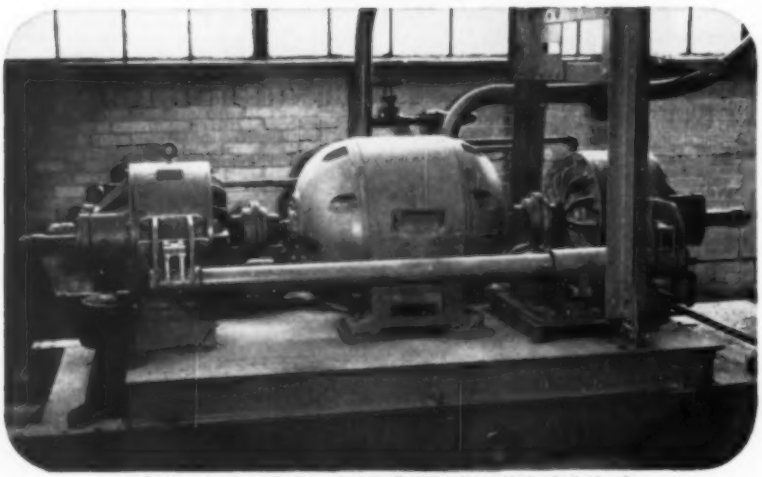
Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

***Mfd. by* C. B. HUNT & SON, INC., 1991 East Pershing St., Salem, Ohio**

Circle 69 on Reader Service Card

POWER FOR CLAY EXTRUSION PRESS SUPPLIED BY

AE HELE-SHAW PUMPS



Hele-Shaw pumps at Canada Vitrified Products Limited. Each of these pumps—size JHP-12—can deliver 44 gpm at up to 2500 psi.

ACROSS THE BORDER, Canada Vitrified Products Limited, St. Thomas, Ontario repowered an existing press with Hele-Shaw pumps to extrude vitrified clay sewer pipe and flue linings. This pumping unit furnishes dependable fluid power for all variations in ram speed and tonnage required for the many shapes and sizes of the finished product. It is remotely controlled by a single lever-operated hydraulic servo cylinder, controlling the amount and direction of flow of oil, in exact proportion to the operator's signal.

The famous Hele-Shaw is a radial-piston variable displacement fluid power generator. It can be very readily applied to the machine it serves... can be installed on the machine, near to it, remote from it, or integrated with the design itself.

Whenever you have a problem involving high pressure hydraulic systems, American Engineering Company may well be able to save both time and expense in planning and construction. Write for full information about the Hele-Shaw for variable displacement (pressures to 3000 psi) or the Hydramite for constant displacement (pressures to 5000 psi).

AMERICAN ENGINEERING COMPANY

DEPT. P-141, WHEATSHEAF LANE & SEPVIVA ST., PHILADELPHIA 37, PA.
Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P. Q.... Bawden Industries Ltd., Toronto, Ont.

AE products are: Taylor, Perfect Spread and Vibra-Grate Stokers, Hele-Shaw and Hydramite Fluid Power, Le-Hed Hoists, Le-Hed Car Pullers, Marine Deck Auxiliaries.

New Products / continued

run for a pre-selected time and then stopped automatically. Standard models are available with one to ten circuits, and time ranges are from 15 seconds to 1 hour. Contacts are rated 15 amp at 115 volts a.c. Con-

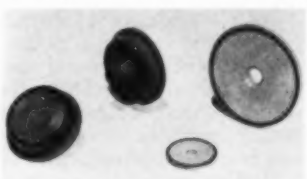
tact closure intervals are adjustable from 0 to 50% of the time cycle. Timer dial includes stop member for use when time setting is to be used repeatedly. Synchronous motor moves pointer toward zero showing amount of time left in cycle.

The Hagen Mfg. Co.
Moline, Illinois
Circle 178 on Reader Service Card

RUBBER-TO-METAL BONDING
... provides smooth sealing surface

Designation: Permadizing

Advantages: Bonding process provides an optically smooth sealing surface assuring perfect sealing even at near-zero pressure. In one application process reduced damaging



swell by reducing rubber content in the bond by 90-95%. Dimensional tolerances can be held as closely as metal—as fine as 5 microfinish. Other advantages are flash-free precision parts, reduction of reworks or rejects due to improper bonding, consistent results, extremely low swell, and high resistance to hydraulic fluids.

Stillman Rubber Co.
Culver City, Calif.
Circle 179 on Reader Service Card

O-RING COMPOUND
. . . improved for -65 deg. F

Designation: Compound 47-761
Features: Compound meets requirements of Specification MIL-P-18017A covered by drawing MS-28784 and is the result of development program to produce better material especially at —65 degrees F. Compound was given additional test of being soaked in low-swell oil for 7 days at 160 degrees F. This test is not included in the specification but is used by several major aircraft manufacturers as a qualification.

Parker Appliance Co.
Cleveland, Ohio

Circle 180 on Reader Service Card

ROTARY SOLENOID VALVE
. . . for aircraft systems

Features: Small lightweight valve has been developed especially for aircraft hydraulic, pneumatic, and fuel systems operating in pressure

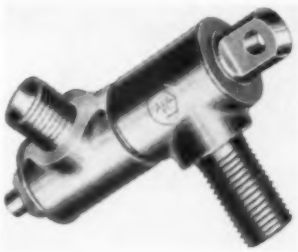
range of 0-3000 psi. Valve features straight-through flow and is available with ports for ¼, ⅜, or ½ inch diameter tubing. All models, either normally open or normally closed function over an extreme temperature range.

Pneu-Hydro Valve Corp.
East Orange, N. J.

Circle 181 on Reader Service Card

SWIVEL JOINT
. . . is pressure balanced

Designation: Rotomite
Design: Low-torque swivel joint is of plane-type design and does not depend upon piping to drive or rotate. The shaft may be actuated with a mechanical drive rod eliminating tube fatigue at piping connections. Simplified design eliminates the need for bearings or other anti-friction parts. Unit is suitable for hydraulic, pneumatic, gaseous, and vacuum installations in aircraft piping systems.



Construction: Several stock assemblies can be selected and snapped together to make different, integral unit arrangements. Swivel joints are corrosion-proof and give trouble-free operation through extreme temperature range.

The Weatherhead Co.
Aviation Division
Cleveland, Ohio

Circle 182 on Reader Service Card

Continued on next page

fixed-bundle heat exchanger

provides greater capacity per square foot of surface

Wherever there's a temperature-control problem, there's a place for a Yates-American Heat Exchanger:

Diesel engines
Torque converters
Die-casting machines
Field processing plants
Hydraulic presses
Solvent coolers
And many other applications

It's new — *but field-proven!* It upholds Yates-American's 74-year reputation for top quality.

Features like these protect your investment:
Tubes are bonded to flanged baffles, to eliminate vibration wear.
Tube joints are rolled, for permanently tight connections.
Copper and copper alloys are used throughout, for long service life.

2" to 10" sizes — single-pass, 2-pass, and 4-pass designs — are now in production. Other fixed-bundle models available on special order. *Removable-bundle types soon in production.*

Bulletin HT-1 gives detailed information. Send coupon for your copy.

Yates-American

BELOIT, WISCONSIN CHICAGO, ILLINOIS, HIGH POINT, N. C., MEMPHIS, TENNESSEE, PORTLAND, OREGON

Tear out coupon and mail today!

YATES-AMERICAN
Dept. L3, 755 N. Fourth St., Beloit, Wis.
Send me Bulletin HT-1.

Name _____
Company Name _____
Address _____
City _____ Zone ____ State _____

10

Circle 154 on Reader Service Card

Circle 29 on Reader Service Card

IF YOU OWN, OPERATE OR MAKE
HYDRAULIC EQUIPMENT

AT NO COST TO YOU, write for your copy of a complete filter-hydraulics manual. Shows how to get smoother, longer operation from equipment of ANY SIZE . . . large or small.

OUTLINES FIVE RECOGNIZED SYSTEMS for the most efficient use of filtered hydraulic fluids; fully covered are pro's and con's of each with diagrams.

STOP INACCURACIES, SHAFT AND PISTON CHATTERING, UNEVEN OPERATION. See how by asking for our no cost trial offer on your own equipment in your own plant.

Briggs
PIONEERS IN MODERN OIL FILTRATION

HYDRAULIC OIL FILTERS

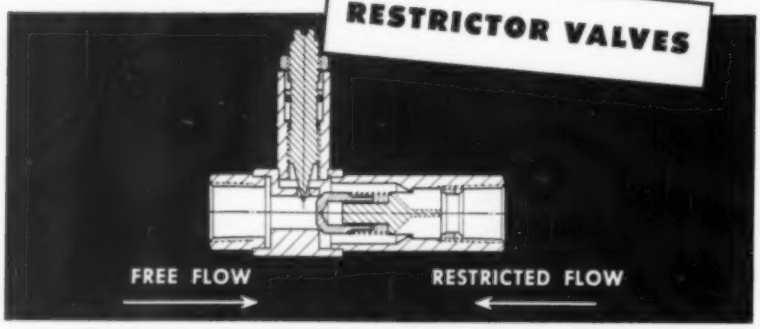
THE BRIGGS FILTRATION CO., Washington 16, D.C., Dept. 126

YES! Send me my copy of "HYDRAULICS" at no cost to me.

NAME .....
COMPANY .....
ADDRESS .....

DEPENDABLE

RESTRICTOR VALVES



- **CAN'T STICK OPEN due to dirt in oil**
- **HOLDS ADJUSTMENT — will not leak**
- **STRONG burst pressure over 10,000 P.S.I.**
- 1/4", 3/8", 1/2" and 3/4" pipe sizes
- For oil at pressures to 3,000 P.S.I.

Write or phone Mentor, Ohio, BLackburn 5-2625 for complete specifications

Fluid Controls, inc.

Manufacturers of Hydraulic Valves and Devices

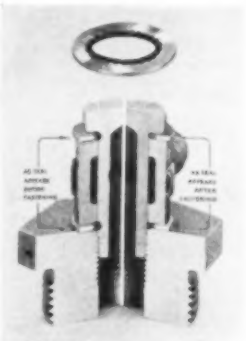
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

New Products / continued

SEALING DEVICE . . . for banjo fittings

Designation: Banj-O-Seal
Design: Seal has special configuration of rubber and retainer metal for sealing to 5000 psi and over. Seal is for air, oil or fuel at temperatures from −65 to +350 de-



grees F or +500 degrees F intermittent. Device eliminates disadvantages of crush washers and provides metal-to-metal contact of faying surfaces. Reusable unit assures no loss of sealing due to cold flow, reverses, or surges. Seal permits use of space saving banjo type fitting in designs which are often rejected due to maintenance difficulty and leakage at the boss and bolt head ends of the fittings.

The Franklin C. Wolfe Co., Inc.
Culver City, Calif.

Circle 183 on Reader Service Card

PRESSED-ON COUPLNG . . . with 360 degree swivel joint

Designation: Anchor Swivel Flanco
Design: 4-bolt, split-flange, pressed-on coupling, with 360 degree swivel joint, threadless, "O" ring seal.
Features: The new, patented swivel joint provides maximum con-

venience in positioning and installing, and prevents the danger of hose twisting. Thinner sections on valve and pump bosses are possible. Savings in material and production costs should be possible through

elimination of pipe threading operations and separate union and swivel connectors. The hose assembly may be connected and disconnected repeatedly without leaks, and only small automotive type wrenches are needed to make up a joint. **Specifications:** Couplings are available in all sizes from ½ inch through 1½ inches, and in all standard bends from 0-90 degrees.

Anchor Coupling Company, Inc.
Libertyville, Illinois

Circle 184 on Reader Service Card

LUBRICATOR FILLING SYSTEM
. . . is automatic supply

Features: System maintains a constant level of lubricant in lubricator bowls from a central oil sup-

ply. System operates with lubricators in ⅜, ½, ¾, and 1-inch pipe sizes and is easily adapted to existing groups of lubricators.

Advantages: System reduces maintenance, repair and down time to minimum and full lubricators are ensured at all times. System provides for safe filling of lubricators in hazardous locations.

Arrow Tools, Inc.
Chicago, Illinois

Circle 185 on Reader Service Card

NEEDLE VALVES
. . . have metal-to-metal seal

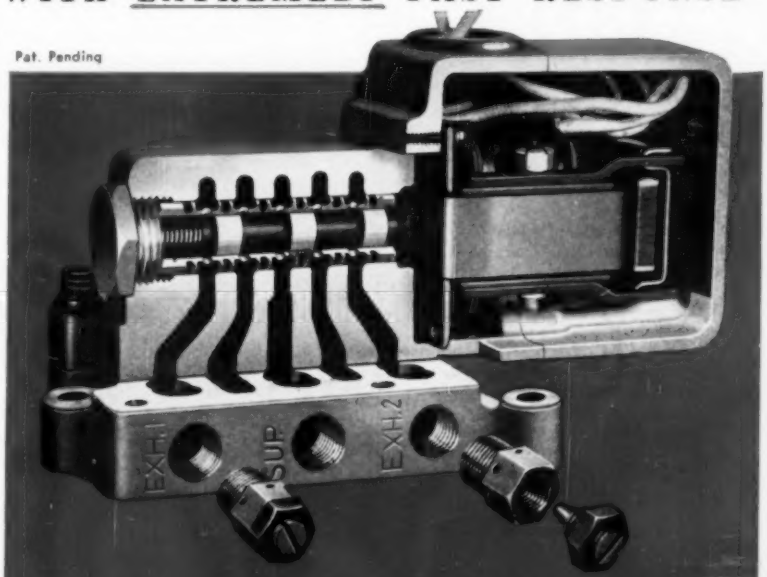
Designation: 3000 Series

Design: Brass valves are for air and liquid applications to 600 psi as shut-off or throttling valves. Units have rugged compact design with overall length of 1⅜ inches. Packing between bonnet and body

Continued on next page

now . . . AIR VALVES
WITH EXTREMELY FAST RESPONSE

Pat. Pending



. . . Almost TWICE As Fast As Ordinary Valves!

The new SA Series single solenoid actuated valves are available in both single and dual pressure models with extremely fast response time. You get total response in 12 *milliseconds*—from energizing to wide open on 60 cycle current. That's almost *twice as fast* as any pilot operated solenoid control valve available today!

All SA Series valves are high performance, full pipe area valves . . . furnished for service on vacuum and air at pressures from atmospheric to 250 psi . . . and at speeds from the most intermittent job in your plant to welding guns. Optional metering valves give simple, sensitive control of piston speed by metering the exhaust air. Exhaust noise is muffled.

The design simplicity of the SA Series valves provides extremely long life and requires a real minimum of maintenance. Only one moving part provides the valving action . . . a corrosion-resistant steel spool and sleeve.

Complete information on the SA Series valves . . . the greatest advance in air controls . . . can be obtained by writing today for your copy of Catalog 8000.

NUMATICS, Inc.

MILFORD, MICHIGAN • **DEPT.** AH

Circle 101 on Reader Service Card

Circle 6 on Reader Service Card

TESTS

AETCO offers unparalleled equipment, skilled engineers and round-the-clock schedules . . . to provide you with every conceivable kind of testing of your products, processes or components.

AETCO maintains high aviation standards in its testing of material for all types of industry. AETCO renders unbiased qualification reports, fully acceptable to governmental and other specifying agencies.

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RUGGED, HEAVY-DUTY
HYDRAULIC CYLINDERS

Attention: O. E. M.
Prompt delivery on any quantity . . . high quality . . . low cost!

Built-in Mechanical Stroke Control

Free catalog and engineering survey, no obligation.

WRITE...PHONE...WIRE
CROSS MFG. CO.
LEWIS ■ PHONE 81 ■ KANSAS

New Products continued

is eliminated by means of a taper, metal-to-metal seat. Valves are available from stock in all combinations

of ⅛ and ¼-inch male and female pipe ports and in ⅜-inch male pipe ports.

Generant Engineering Co.
Newark, New Jersey
Circle 186 on Reader Service Card

3-WAY SOLENOID VALVE
. . . small, light, inexpensive

Designation: 100400 Series

Design: Pilot valve is designed for maximum leakage of 5 cc/min and has a weight of 7 oz. Qualified according to MIL-V-5529A, the valve is available from stock.

Specifications: Unit is suitable for service to 3000 psi in ambient

temperature range of −65 to +275 degrees F. Solenoid is continuous-duty type with operating range of 18-30 volts d.c. and maximum drain of 1.0 amp at −65 degrees F. Standard units are available with porting according to AND10056-4 and with optional manual over-ride.

Fisher Controls, Inc.
Santa Monica, Calif.
Circle 187 on Reader Service Card

TEFLON HOSE
. . . with reusable fittings

Application: Hose is recommended for applications where unusual exposure to wide temperature ranges and injurious chemical action is encountered. Temperature range of hose is −100 to 500 degrees F. Detachable, reusable fitting is leakproof even after aging of hose, and may be assembled easily with simple hand tools. Male pipe and JIC swivel fittings are available for the hose.

Aeroquip Corp.
Jackson, Michigan
Circle 188 on Reader Service Card

AIR CYLINDER
. . . with integral valve

Designation: Model SVS

Operation: Solenoid valve controls movement of cylinder when air is connected to single port. Valve is air-return, 4-way type without

springs, and will cycle at 800 strokes per minute. Solenoid is rated at 110 volts, 60 cycles and is silent in operation. No air bleeds to atmosphere after the spool in the valve has shifted to either one of its two positions. Cylinder operates on air pressures from 5 to 150 psi.

A. K. Allen Co.
Brooklyn, N. Y.
Circle 189 on Reader Service Card

PRESSURE SWITCH
. . . senses two pressures

Designation: 9622, C9622

Operation: Pressure switch senses two different pressures in one system and actuates independent electrical circuits at any two desired points. The unit may be used to maintain a pressure where it is imperative that the system pressure does not exceed or fall below predetermined values. Switch senses pressure over adjustable range of

Continued on page 164

In the Spectacular PLYMOUTH ENGINE PLANT you see

(Above) View of Plymouth Engine assembly line

VICKERS®
HYDRAULICS
Wherever You Look

Plymouth Engine Plant is 980' long and 500' wide. Indicative of its scope is crankshaft machining requiring 4500 linear feet of automation composed of 385 individual units. Plant capacity is 150 engines per hour.

In the new Plymouth "Qualimatic" Engine plant you see Vickers Hydraulics on every side. Hundreds of machines in this latest and greatest example of automation are Vickers equipped.

Both builders and users of production equipment appreciate the significant advantages of Vickers Hydraulics . . . advantages that help produce better products at lower cost.

A specific need in the Engine Plant is standardization on a few basic hydraulic units to keep down parts inventories. The Vickers line makes standardization easy. Also desirable are hydraulics in units quickly demountable . . . so that by replacing units, repairs on the job are avoided and costly downtime reduced. Vickers has extensively developed demountable unit construction.

Whether automated or not, more and more plants have more and more Vickers Hydraulics. For further information, write for Catalog 5002B.

VICKERS HYDRAULICS is used on machines supplied by these Companies to Plymouth Engine Plant

American Broach & Machine Co.
Barnes Drill Company
Bilt-Rite Tool & Machine Co.
Buhr Machine Tool Company
Colonial Broach & Machine Co.
Crankshaft Machine Company
The Cross Company
Ex-Cell-O Corporation
Fitchburg Engineering Corp.
Greenlee Bros. & Company
Industrial Metal Products
The LaPointe Machine Tool Co.
Landis Tool Company
The R. K. LeBlond Machine Tool Co.
Lees-Bradner Company
Michigan Drill Head Co.
Micromatic Hone Corporation
Micro-Poise Engineering & Sales Co.
Modern Industrial Engineering Co.
The Motch & Merryweather Machinery Co.
Norton Company
A. P. Schraner Co.
The Sheffield Corporation
Snyder Tool & Engineering Co.
Sundstrand Machine Tool Co.
Jervis B. Webb Co.
The Wickes Corp.
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VICKERS INCORPORATED
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IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto

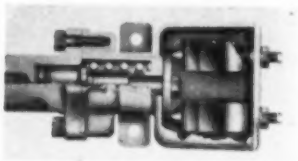
7545

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

New Products continued

15 to 3000 psi, and has two independent SPDT snap switches for a.c. and d.c.

Construction: Pressure settings are made by two external adjustment screws which can be locked in place. Switch is provided with mounting bracket which may be rotated to any position on a full circle or moved up and down on the neck of the switch. Model C9622 has two calibrated dials which permit setting either switch, without gages before or after installation on a pressure line.

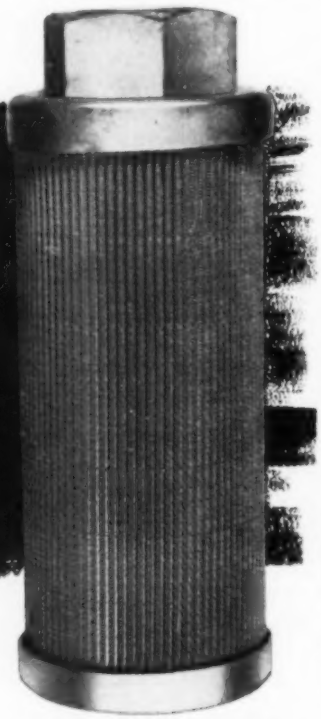


Barksdale Valves
Pressure Switch Div.
Los Angeles, Calif.
Circle 190 on Reader Service Card

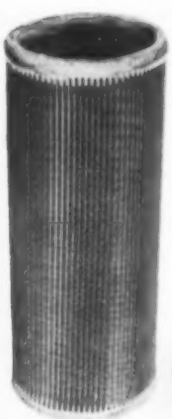
Capital

HYDRAULIC OIL FILTER with Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS



★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

SOLENOID AIR VALVE
. . . for simple maintenance

Features: All control parts of the valve can be removed in one small assembly without disturbing the piping, by loosening one nut. Normally closed valve is available in

standard pipe sizes from ¼ to 2 inches. Having only two moving parts, the valve assures a positive, high-speed action with short plunger travel. Valve can be mounted in any position and operated continuously without harm to the valve or solenoid.

Airmatic Valve, Inc.
Cleveland, Ohio
Circle 191 on Reader Service Card

HYDRAULIC VALVE
. . . is air operated

Designation: Model 5950
Features: Hydraulic 4-way valve is available in standard action, spring-return, and spring-centered models. Designed for 1500 psi, valve is available in sizes of ¼, ⅜, ½, ¾, 1, 1¼, and 1½ inches. Spring-centered valves are available in five piston designs.

Construction: In floating-piston design, valve piston has a precision fit with the valve bore. Valve stem is supported in bearings in the

valve covers without influencing fit of the piston in the valve bore.

This assures leakproof operation and provides smooth, positive opening and closing. Large passages provide smooth, full capacity flow.

Rivett, Inc.
Boston, Mass.

Circle 192 on Reader Service Card

SILICONE RUBBER COMPOUNDS
. . . use standard mold

Features: Three advanced silicone rubber compounds particularly suitable for producing O-rings complying fully to AN, MS, SAE, JIC and NAS dimensions and tolerances are now available. These compounds, supplied in durometer hardness of 60, 70, and 80 are useful in the temperature range of —80 to +500 degrees F. Because the molding shrinkage duplicates that of organic rubbers, special tooling is eliminated.

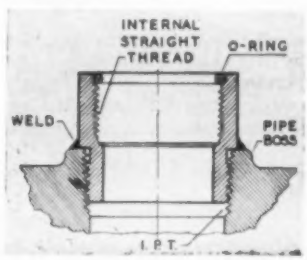
Advantages: O-rings fabricated from the new compounds have more consistent in-tolerance dimensions, and permit greater use of standard tooling. In addition to the usual silicone rubber properties, the compounds are non-toxic, and have zero moisture absorption even when completely submerged in boiling water.

Goshen Rubber Co., Inc.
Goshen, Indiana

Circle 193 on Reader Service Card

STRAIGHT THREAD ADAPTER
. . . permits simple change-over

Designation: FG5-S



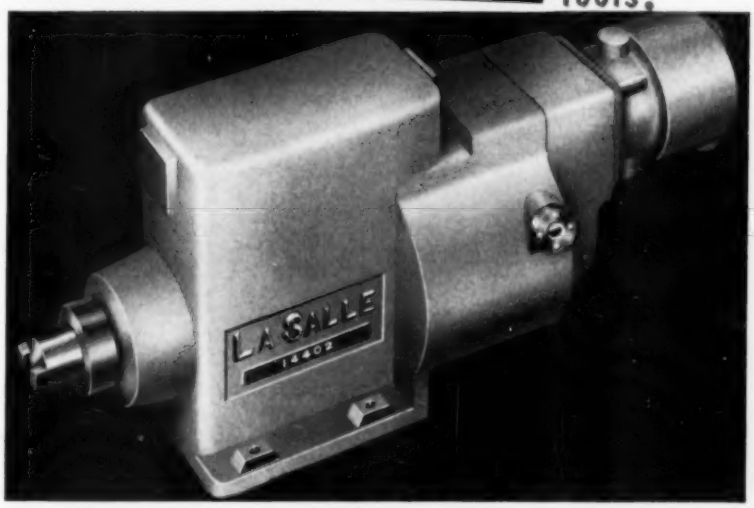
Features: Fitting facilitates change-over from pipe threads to straight

Continued on next page

La Salle

AUTOMATIC | POWER | WRENCH

practically eliminates breakage of cutting tools!



IT'S NEW!

two-speed fully automatic power
It's synchronized with the machine cycle to give you automatic engaging and disengaging of parts. Controlled torque eliminates positively all guesswork in clamping pressure.

operates on machine tool principles
A high speed low torque approach; a low speed high torque clamping; and a low speed high torque break clamp and a high speed low torque return.

STARTLINGLY DIFFERENT!

features fluid motor drive
You can clamp light parts or parts with thin-walled areas without fracturing and you can always repeat the clamping torque from cycle to cycle.

fits any type of production machine
They're designed to fit any special or any standard machine in use today—such as Multiple-Drilling Machines, Lathes, Boring Mills, Grinders, Screw Machines or Thread Millers.

GOOD NEWS FOR PRODUCTION MANAGERS!

unit mounted quickly
The design permits either vertical, horizontal or angular mounting—to serve your particular needs.

now available in two standard sizes
Smaller model has a torque capacity up to 1200 inch/pounds; larger model from 800 to 5000 inch/pounds. To control and regulate properly a hydraulic power package is provided.

La Salle tool, inc.

ENGINEERING & BUILDING SPECIAL MACHINERY
3840 East Outer Drive • Detroit 34, Michigan

Circle 80 on Reader Service Card

New Products / continued

threads in various applications such as valves or other units that are too large to be removed to a bench for re-machining of the ports. Adapter is especially useful with large equipment where the hydraulic units are bulky and heavy. Fitting is installed by screwing into port. It is then welded for a permanent joint, leaving the other end of the adapter which provides the straight thread mounting boss.

The Parker Appliance Co.
Cleveland, Ohio

Circle 194 on Reader Service Card

PRESSURE SHUT-OFF VALVE ... for aircraft applications

Features: Valve is designed for hydraulic, pneumatic, and fuel systems to provide positive and automatic protection against system overload. When main pressure supply goes beyond the maximum operating pressure, the system is automatically shut off. When the main pressure supply drops to within the limits of the system, the system is re-connected.

Specifications: Standard units with ¼-inch tube size inlet and outlet connections per AND10056-4 are available from stock in all shut-off pressures from 20 to 6000 psi.

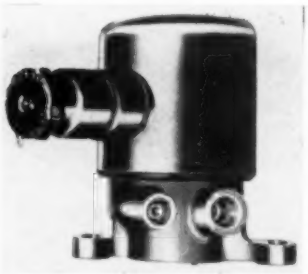
These units weigh approximately .3 lb and have an ambient temperature range of −65 to +275 degrees and a maximum operating pressure of 10,000 psi.

Fisher Controls, Inc.
Santa Monica, Calif.

Circle 195 on Reader Service Card

AUTOMOTIVE PUMP ... has reduced controlled flow

Designation: VT-24



Features: Generator mounted pump for automotive steering systems has reduced controlled flow and lower operating temperatures at high engine speeds. Rotating elements are contained within the reservoir which has a capacity of 38.5 cu. in. Integral valve provides overload relief protection in the range of 750 to 900 psi. Pump inlet is supercharged.

Specifications: Delivery is limited to 2.3 gpm regardless of engine speed. Rated capacity is 2.95 gpm takes SAE inverted flare-type fit- at 1200 rpm. Pressure connection

TRU-O-SEAL
TEFLON SEAL
PAT. PENDING

STOPS PIPE THREAD LEAKS instantly!

Prevents future leaks!

TRU-O-SEAL does away with messy pipe "dope" compounds, eliminates damage caused by overtightening of conventional leaky joints, and is immune to ALL known hydraulic fluids and to steam, air, water, solvents, and practically all gases and chemicals. It withstands temperatures from —100° F. to plus 500° F., saves cost and labor of special or welded fittings, and has been fully field tested and proven by leading manufacturers. Comes in ⅛" to 2½" pipe thread sizes.

1 Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed). SEAL SIDE

2 Thread pipe or fitting 4 threads into port. Point in desired direction.

3 Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

Write for data and prices

TRU-O-SEAL DIVISION Flick-Reedy Corporation

2008 N. Hawthorne Melrose Park, Ill.

"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.

Check with LYNAIR FIRST!
ON YOUR AIR AND HYDRAULIC CYLINDER REQUIREMENTS

REGARDLESS OF YOUR NEEDS WE CAN SUPPLY THEM

Check these Advantages

- √ We engineer and manufacture Air and Hydraulic Cylinders for every application
- √ Cylinders meet J. I. C. standards
- √ Airdraulic cylinders for controlling feed in both directions
- √ New design Piston Packing assures minimum of bypass on hydraulic cylinders
- √ Complete range of sizes, 1½" bore through 8" bore, standard. Larger sizes on request.
- √ A full range of Air and Hydraulic Boosters.

Delivery to meet your requirments.

WRITE FOR NEW CATALOG

LYNAIR Inc. 3100 E. MICHIGAN AVE. JACKSON, MICHIGAN

Circle 140 on Reader Service Card

Circle 86 on Reader Service Card

takes SAE inverted flare-type fitting for ⅜-inch diameter hose. Return port is for ⅝-18 straight connector.

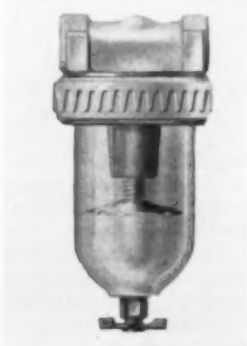
Installation: Pump is directly driven through a coupling connection from the generator shaft. Mounting flange has slots which permit rotation of the pump on the generator to keep reservoir filler spout vertical following generator adjustment for belt tension.

Vickers, Inc.
Detroit, Mich.

Circle 196 on Reader Service Card

AIR LINE FILTER
. . . 20, 40, 90, micron

Operation: Air action whirls condensate and larger impurities to the outer shell where they spiral downward until trapped in the "quiet" chamber under the baffle plate. The air with its smaller remaining impurities flows through



the porous bronze filter cone where particles are filtered out.

Specifications: Filter is available with female Dryseal pipe connections in sizes ¼, ⅜, and ½ inch. Bowl capacities of 1/3 and ½ pint. Transparent bowls are for pressures to 150 psi and temperatures to 120 degrees F. Metal bowls are for pressures to 250 psi and temperatures to 300 degrees F. Filters are also available in combination units consisting of filter, regulator, and lubricator.

Industrial Div.
Watts Regulator Co.
Lawrence, Mass.

Circle 197 on Reader Service Card

GEAR PUMP
. . . pressure balanced wear plates

Designation: PA-3000 Series

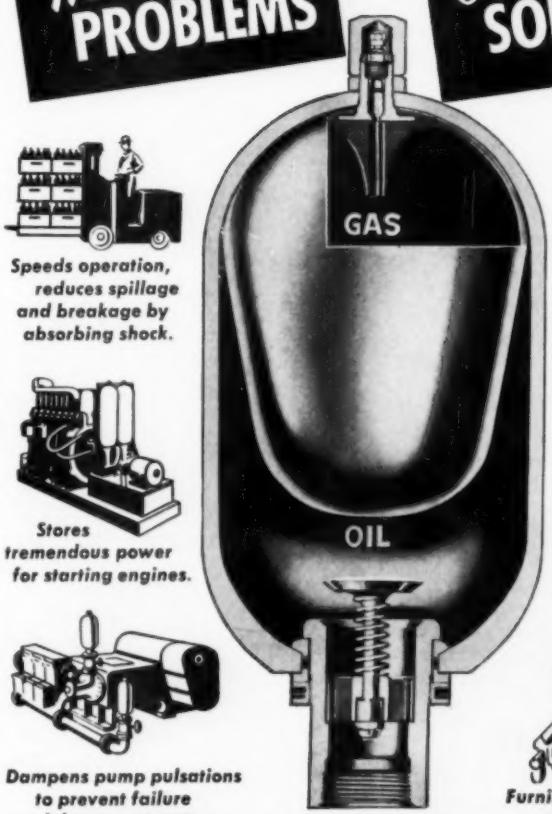
Features: Designed especially for industrial use, the pump has a straight key shaft for pulley drive or rigid and flexible couplings. The pump operates at pressures to 1500 psi at 2000 rpm and delivers 40 to 70 gpm.

Design: An important feature of the pump is the pressure balanced wear plates. By balancing pressure on front and back of the wear plates, a fixed clearance is maintained between the wear plates and gear faces regardless of pressure. Oil slippage is reduced to a minimum, and there is no excessive power loss due to the force of the plate against the gears.

Kalamazoo Div.
New York Air Brake Co.
Kalamazoo, Mich.

Circle 198 on Reader Service Card

Many **PROBLEMS** *One* **SOLUTION**



Speeds operation, reduces spillage and breakage by absorbing shock.

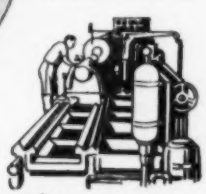
Lets small motors and pumps operate big presses.

Stores tremendous power for starting engines.

Reduces size, cost, weight, complexity of machine tools.

Dampens pump pulsations to prevent failure and damage to system.

U. S. Patents under Olaer Licenses



Furnishes emergency power when pump fails.

Planning a new product? Improving your present equipment? It will pay you to consider using the Greer Accumulator. The application of the most versatile hydraulic component ever devised means improved performance, lower manufacturing and maintenance costs, and greater on-the-job efficiency for your hydraulically operated equipment. Learn how the Greer Accumulator can help you as it has so many others. Write or call Greer engineers for technical assistance with recommendations. No cost or obligation, of course.

Write for Bulletin 301-A for data and diagrams today.

GREER HYDRAULICS INC. • NEW YORK INTERNATIONAL AIRPORT • JAMAICA 30

an ACCO product

Helicoid Gages

How HELICOID GAGES can save YOU money!

LONG LIFE:

HELICOID Gages are pressure instruments of extreme precision and long, trouble-free service with minimum maintenance. Have no gear teeth to wear out.

SUSTAINED ACCURACY:

HELICOID Gages have many unique and exclusive features which result in the highest degree of gage accuracy. Tubes, for instance, will withstand hundreds of thousands of pressure pulsations and will not stretch, leak or crack.

JOB-DESIGNED:

HELICOID Bourdon tubes are made from seamless tubing of alloy steel, K Monel, stainless steel or phosphor bronze. Each is designed to give best service under specific conditions. Available in complete line of cases for wall or stem mounting.

Acaloy square flush case

Helicoid Chemical gage

Send for catalog

ACCO

Helicoid Gage Division

AMERICAN CHAIN & CABLE

929-H Connecticut Avenue • Bridgeport 2, Connecticut

for Better Value

Circle 65 on Reader Service Card

Useful Literature / continued

SHAFT COUPLING . . . for misalignment to 12 degrees is described in Catalog 62 from Ajax Flexible Coupling Co. In addition to specifications on standard forged steel couplings, the catalog also gives information on floating shaft couplings, and mill motor type couplings which are designed for use in steel mills, or wherever starting or shock loads are encountered. The couplings are designed to provide more tooth strength under misalignment, and the load is carried at the center of the teeth which is the point of greatest strength. All teeth are case hardened, and positive seals keep lubrication in and dirt out. The couplings are available for maximum angular misalignment of 4, 7, and 12 degrees.

Circle 227 on Reader Service Card

PRESSURE REDUCING VALVES . . . temperature regulating valves, and other valves are outlined in Catalog 56C published by Atlas Valve Co. Many types of valves are illustrated with a short description of their application and specifications. Included is an air-loaded, diaphragm-operated, balanced-piston, reducing valve for initial pressures to 6000 psi and reduced pressures as low as 100 psi. The valve has easy adjustment, remote control operation, a wide range of reduced pressures and accurate regulation. Internal parts are hard chrome plated or stellite faced. The valve reduces pressure without shock or chatter, and holds the set pressure closely. It is tight closing, and available with air pilot, gage, and fittings.

Circle 228 on Reader Service Card

ELECTRIC MOTORS . . . manufactured by Diehl Manufacturing Co. are described in Consolidated Catalog & Price List No. 3480. The catalog specifies integral horsepower motors in old and new NEMA frames, flat-type motors, power transmitters for rapid start-stop machine operation, disc-brake motors, and adjustable bases. In addition a section is devoted to engineering data on such subjects as standard motor speeds, insulation, dynamic balance, temperature rise, torque characteristics, and calculation of torque and horsepower. Also

included in this section are representative speed/torque curves, a selection chart for ordinary applications, and method of calculating moment of inertia.

Circle 229 on Reader Service Card

BEARINGS . . . 128-page Catalog No. 52-A lists the complete line of precision bearings manufactured by McGill Manufacturing Co. An engineering section listing formulas and complete data for use in determining various bearing loads is also included. These formulas show how to compute horsepower and torque; how to determine values of radial

and thrust loads; how to equate distribution of loads in relation to bearing location; and how to compute radical loads due to belt, chain, or rope drives. Formulas are also included for determining the forces acting on various types of gears and and determining the centrifugal and inertia forces that act on bearings. Complete specifications and dimensions are listed for each type and size of bearing. Bearings listed for the first time are the prelubricated and sealed models. Other data includes weights of bearings.

Circle 230 on Reader Service Card

HYDRAULIC TEST STAND . . . to produce a maximum flow of 33 gpm and pressure to 5000 psi in the main flow system is included in a leaflet from Test & Ground Support Equipment Div., Pacific Airmotive Corp. The static test circuit of this self-contained test stand develops 10,000 psi. Also included in the literature is a test stand for hydraulic pumps, fuel and vacuum systems, and accessories.

Circle 231 on Reader Service Card

SWIVEL JOINTS, CHECK VALVES . . . are explained in three bulletins released by Sealol Corp. Bulletin 15 describes swivel joints in pipe sizes from ¼ to 1½ inches, pressures to 3500 psi, and temperatures to 350 degrees F. Also included are aircraft types which have been tested in accordance with Specification MIL-J-5513. Bulletin 16 presents rotary joints for speeds to 1750 rpm. These have a balanced piston design to control the effect of line pressure on the sealing surfaces and reduce face contact pressures to a minimum. Bulletin 16 covering check valves shows units for industrial and aircraft applications for use with pipe or tubing connections. The valves are made in pipe sizes from ¼ to 1½ inch and tubing sizes from ⅛ to 1 inch. Construction of the valves is such that foreign matter in the system has little effect on the positive checking.

Circle 232 on Reader Service Card

NYLON TUBING . . . The Polymer Corp. of Penna. has released a brochure, case history sheets, and technical bulletins describing its flexible Nylon tubing for pressures to 2500 psi. The technical bulletins

Continued on next page

LENZ "O-RING"
NO METAL TO METAL SEAL
J.I.C. APPROVED
HELD BY FRICTION GRIP OF THESE TWO
NO CONCENTRATION OF STRESSES DUE TO FLARES OR FERRULES FOR TUBE FAILURE
NO EXACT TUBE LENGTH NECESSARY
NOT NECESSARY TO CUT TUBE SQUARE
SEAL AND GRIP ARE SEPARATE
REDUCER COUPLINGS
Reducer couplings are adapters for standard bodies, making possible line reductions on any leg by use of standard adapters and adapter nuts.

. . . A Hacksaw And A File Are All You Need

Excessive wrench torque is unnecessary for seal does not depend upon tightness of the nut. The higher the pressure the tighter the grip. Solve your hydraulic piping problems the easy way . . . with ease of assembly . . . no matching of exact tube lengths . . . simple leakproof connection for the life of the tube.

Reusable collet holds by friction grip up to bursting pressure of tubing.

LENZ FITTINGS MAKE THE JOB AS SIMPLE AS A B C

LENZ COMPANY

See our Catalog Page in Thomas Register 1956 Edition, Vol. 1, under classification "Fittings: Hydraulic" for complete list of types and sizes.

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DISTRIBUTORS IN PRINCIPAL CITIES

Circle 81 on Reader Service Card

Shenango
CENTRIFUGALLY CAST COMPONENTS

...for exceptional performance in hydraulic service

SHENANGO offers specialized production of cylinders and all other symmetrical components, small or large, ferrous or non-ferrous, rough machined or finished to your specifications. Produced by the Shenango centrifugal casting process, they assure:

- **Uniform, *pressure-dense* grain for greater strength and superior wear resistance . . .**
- **Freedom from inclusions and avoidance of porosity . . .**
- **A minimum of machining and faster finishing with excellent surface characteristics.**

Find out if Shenango specialization can spare you cost and trouble. Get acquainted also with Shenango centrifugally cast tubular *stock* available in a broad range of diameters and lengths. For helpful bulletins or engineering service write Centrifugally Cast Products Division, The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS

Useful Literature / continued

discuss properties and applications of the tubing, covering such subjects as methods of testing pressure, cold temperature limit, flexural fatigue, and abrasion. Other technical bulletins indicate how to determine burst strength of the tubing; compare it with other tubing; give minimum bend radii and other installation information; and show various flare, compression, and special fittings. The tubing has excellent abrasion and impact resistance and will withstand severe general mechanical abuse. Although it should not be used in an oxidizing atmosphere for continuous duty at temperatures in excess of 180 degrees F, it can be expected to be usable at temperatures of 350 to 400 degrees F for short periods of time.

Circle 233 on Reader Service Card

SHAFT COUPLINGS . . . are the subject of 26-page Bulletin 4100 produced by The Falk Corp. A section of the booklet is devoted to information on selection of the couplings for various types of drives. Examples of selection methods are given for motor and turbine drives and for engine drives. A table of service factors is included for numerous applications. Other tables permit selection of coupling size for horsepower ratings from ¾ to 300, service factors from 1.5 to 3, and speeds from 7.5 to 300 rpm. Complete specifications are given for various types of couplings and numerous applications are pictured.

Circle 234 on Reader Service Card

VALVES FOR MOBILE EQUIPMENT . . . is the subject of attractive 92-page Catalog H-12 published by The Commercial Shearing & Stamping Co. Youngstown 1, Ohio. To show performance ratings of various directional valve types, twelve curves are plotted showing internal pressure drop through the valve as a function of flow. These indicate the characteristics of valves with 1 to 10 individual sections. A line drawn across the curves shows pressures at which excessive heating of the oil will occur unless cooling is provided. The data for each set of curves is tabulated with a sectional drawing of the valve type. Descriptive material covers function, intended usage, principal

dimensions, cutaway views, flow operation, schematic drawings, and part number. Schematic drawings are included to show many common valving arrangements. These drawings show the fluid flow through the different valve elements as various actions are performed. In addition to directional valves, counterbalance valves and overload relief valves are included. Copies of the catalog can be obtained by requesting on company letter-head.

QUICK DETACHABLE COUPLERS . . . are the subject of a new catalog containing information on semi-automatic and regular

couplers for air, oil, and grease lines. Available from Foster Manufacturing Co., the catalog also describes a line of chrome sleeves and air, oil, and grease line fittings showing practical applications of the fittings with various air operated tools.

Circle 235 on Reader Service Card

FLOW CONTROLS . . . Basic hydraulic restrictor and needle valves, and adjustable pressure-compensated flow regulators are shown in Catalog No. 553 released by Fluid Controls, Inc. Capacity ranges, pipe sizes, and dimensions of each type and also included and arranged in simple form. Also featured is a section illustrating a wide variety of other models of basic types of controls which are now stocked.

Circle 236 on Reader Service Card

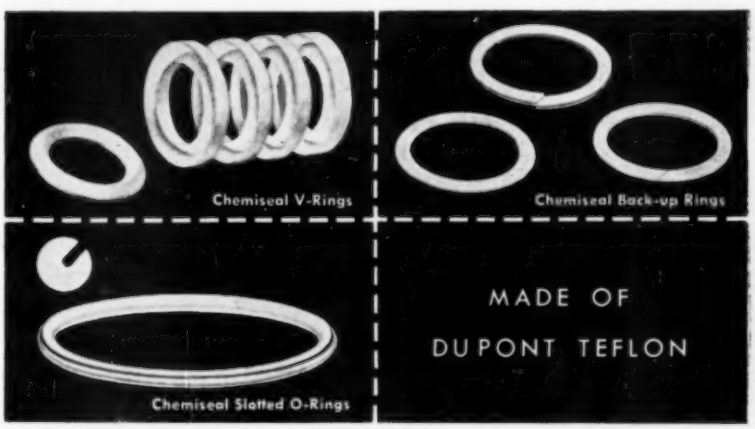
MAGNETIC LIMIT SWITCH . . . designated a proximity switch is outlined in Bulletin PS released by Doelcam Div. Minneapolis-Honeywell Regulator Co. The switch is a magnetic device with

Continued on next page

where failure is unthinkable..

Why are Chemiseal packings preferred by leading hydraulics engineers?

Because they know Chemiseal packings provide the maximum security at vital points. Made of TEFLON, they are chemically impervious, require no chemical inspection. Have zero swelling in all hydrocarbons, new synthetic hydraulic fluids and solvents. Offer unsurpassed anti-friction properties. Are tough, resilient,



non-flammable, long wearing. Have service temperature range from minus 110° F. to plus 500° F.

Have you tested the new Chemiseal Slotted O-Rings (patented) that provide greater cross sectional deformability, thermal expansion compensation and automatic pressure sealing action?

Chemiseal Back-up Rings made in spiral, solid and split ring types that prevent O-Ring extrusion and greatly lengthen their life.

Chemiseal V-Ring packings, that seal with unusually low gland pressure and operating torque?

Write for further information and samples.

UGS BELMONT

UNITED STATES GASKET CO.

CAMDEN 1, NEW JERSEY

Circle 142 on Reader Service Card

Useful Literature continued

no moving parts. It detects the presence of a ferrous object without requiring physical contact. Detection is accomplished when the object passes through the magnetic field set-up directly in front of the switch sensing end. The switch supplies an electrical signal to operate an external relay and may be operated 10 times per second. The bulletin gives typical applications, dimensions, and performance specifications. When a block of ferromagnetic material is moved within 1/8-inch of the pole face the switch has a differential distance between pick-up and drop out of less than 7/32 inch.

Circle 237 on Reader Service Card

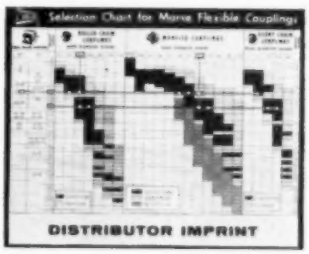
HOSE CLAMP . . . which is locked in place with a punch is outlined in a data sheet released by Punch-Lok Co. The sheet includes tables of stock sizes for preformed clamps and open-end clamps. The clamp is a broad, flat band of galvanized steel which is double wrapped around the hose. After tensioning with the locking tool, the clamp is locked in place by an inter-nesting of the outer part of the lock and the double wrap of bands. The clamp is recommended for pneumatic tool hose and suction and discharge hose among other applications. Also shown in the sheet are the clamp tools, hose fittings, nipples and a clamp kit.

Circle 238 on Reader Service Card

STEEL TUBING . . . for hydraulic cylinders and fluid lines is the subject of a brochure issued by Joseph T. Ryerson & Son. The material is divided into sections on cylinder-finish tubing, hydraulic fluid line tubing, welded cylinder tubing, and seamless tubing for honed cylinders. A section on turned, ground, and polished bars for pistons and accessories is also included. The section on fluid line tubing, covers the subject of steel analysis; physical properties of tensile strength, and elongation; cleanliness; and workability. A table of stock sizes and calculated bursting pressures shows sizes from 1/8 to 2 inches OD. The seamless mechanical tubing drawn to OD and ID tolerances for honed cylinders is stocked in sizes from 2 to 9 inches OD.

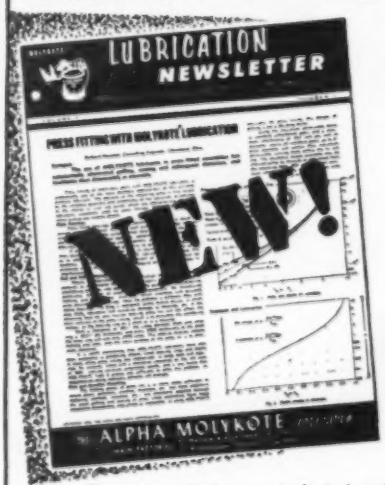
Circle 239 on Reader Service Card

FLEXIBLE COUPLING SELECTION CHART . . . A new coupling selection chart developed by Morse Chain Co. reduces the time



required to select a flexible shaft coupling. To determine the smallest size coupling that will accommodate the shafts, the chart gives condensed critical specifications of three types of couplings. Both old and new NEMA frame numbers are listed in

A TECHNICAL NEWSLETTER ON LUBRICATION WITH MOLYKOTE . . .



IF YOU HAVEN'T RECEIVED YOUR COPY SEND FOR IT RIGHT AWAY!

Every issue features a technical article on the use of MOLYKOTE Lubricants in industry ● "How-to" stories on tough lubrication applications ● Filled with engineering data which applies to all industries ● Being published regularly.

THE ALPHA MOLYKOTE CORP.

Main Factories: 65 Harvard Avenue, Stamford, Conn.
71 Arnulfstrasse, Munich 19, Germany

Circle 10 on Reader Service Card

Modernair

NEW 1/4" SOLENOID VALVE

for Air or Oil Hydraulic Service, 30 to 150 p.s.i.

★ ULTRA COMPACT...only 4-9/16" long, 3-5/16" high, 1-3/4" wide overall!
★ NON-CORROSIVE CONSTRUCTION...brass and aluminum throughout.
★ "O" RING SEALS...replaceable without disturbing piping.
★ AVAILABLE IN SINGLE OR DOUBLE SOLENOID for all popular a.c. or d.c. voltages.
★ 3-WAY (3 port) OR 4-Way (5-port) MODELS, with or without exhaust speed control valves as shown. Standard ports are female 1/4" NPT.

MODERNAIR's new BV Series 1/4" solenoids put the answer to scores of fluid power control problems literally in the palm of your hand. Why not get the facts now? Write or wire for specifications, prices.

Modernair CORPORATION

Dept. B-10, 400 PRETA ST., SAN LEANDRO, CALIF.
Member National Fluid Power Association 20

Circle 93 on Reader Service Card

sequence according to shaft size. Under each separate coupling heading, the bore diameter range is indicated by a color code as a cross reference with the appropriate shaft size. These colors indicate stock coupling halves complete with finished bores, keyway, and setscrews; minimum plain bores and all listed bored diameters which may be obtained by reboring to size; and collar type flange which may be rebored to larger diameters than can be obtained in the standard oval type flanges.

Circle 240 on Reader Service Card

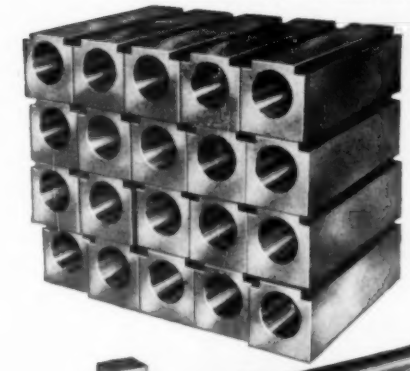
DIRECTIONAL CONTROL VALVES . . . with 3 and 4-way plungers are described and specified in Bulletin 80300 published by The Oilgear Co. Available in eight pipe sizes from ½ to 3 inches, the valves are for systems to 3000 psi. Included in the bulletin are details of the valve body construction and the functions of standard and special plungers. Over 100 special plungers are available. The valves are fitted with operators for manual, mechanical, hydraulic, and solenoid-hydraulic operation. Features of the units including alloy steel valve plungers; confined O-ring seals; screw or welded pipe flanges; and large bodies, plungers, and passages are discussed. JIC symbols for the various types are shown with sectional diagrams of the spool and port arrangements. In addition to complete constructional and dimensional specifications for the standard valves, a page is devoted to special valves.

Circle 241 on Reader Service Card

SELF-LOCKING FASTENERS . . . having a nylon plug imbedded permanently in the threaded section are discussed in Condensed Catalog 11A presented by The Nylok Corp. The locking principle can be applied to any male or female threaded part making a positive, leakproof joint which cannot be jarred loose by shock or vibration. This eliminates the need for lock washers, jam nuts, safety wiring, or other locking devices. Because of the "plastic memory" feature of nylon, the fastening can be removed and reinstalled repeatedly. The catalog lists and describes the complete range of standard, self-locking bolts and screws, set screws, hex nuts, threaded inserts, clinch nuts, and cap nuts. Also described are numerous applications of special purpose fasteners.

Circle 242 on Reader Service Card

Circle 12 on Reader Service Card



Hydraulic CYLINDERS to specification

AT your service — since 1918 — the most modern machine tools to handle up to 15" I. D., including the last word in honing equipment and the most accurate of precision gauging equipment. Everything we do is to specification. Expanded facilities permit prompt delivery of 1 or 1000 pieces in any material desired.

Call Erie 2-3664 - Send specifications to

AMERICAN HOLLOW BORING COMPANY

1954 Raspberry St., Erie, Pa.

PROVED AND ACCEPTED

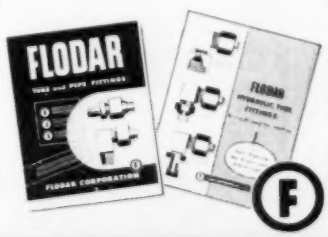
FLODAR'S O-RING LOCKNUT STRAIGHT THREAD FITTING

★ Positive—Leakproof
★ Meets SAE and JIC Standards
★ Safer High Pressure Connections
★ Easy to Position —Interchangeable.

Available in FLODAR'S Self-Flaring, No Flare and Flare type fittings ⅛ to 2" O.D.

Following exhaustive tests in the field, this new Flodar fitting has successfully met all conditions and problems in the piping industry. Extremely easy to assemble and position. Stocked in all styles, sizes ⅛ to 2 inches.

WRITE for our two new CATALOGS



FLODAR CORPORATION

16911 St. Clair Avenue Cleveland 10, Ohio

Post Scripts of Industry

News about people, manufacturers and sales organizations

Domenic A. DiTirro
Valvair Corporation

Domenic A. DiTirro has joined the **Valvair Corporation** as manager of research and development. He will direct new product design, development and testing, and will supervise the activities of Valvair's newly established research and development department. DiTirro has until recently been associated with Ross Operating Valve Company and prior to that with Parker Appliance Co.

James M. Canaris
The Briggs Filtration Co.

James M. Canaris has been assigned to the sales engineering staff of **The Briggs Filtration Company.** For the past eleven years Canaris served as vice president in charge of engineering of the Lofstrand Company.

The newly created position of sales manager for original equipment. liquid filters division of the **Dollinger Corp.** has been filled by **Maurice I. Roth, Jr.** He was formerly associated with the Indiana Commercial Filters Corp.

Ralph A. Lamm
Bendix Aviation

Ralph A. Lamm has been appointed director of engineering of **Bendix Aviation Corporation's Pacific Division.** He joined the company in 1955 and had been head of Special Missile Development at Bendix Research Laboratories Division. For his work on the "Bat", America's first operational guided missile, he received the Presidential Certificate and the Certificate of Merit from the Navy Department.

Fred J. Fleischauer has become chief design engineer of the **Special Machinery Division of The Teller Company.** This division is concerned with industrial automation and plant mechanization.

Aetna Industrial Corporation of New York, has acquired the major assets of **Graton & Knight.** This transfer does not include the International Packings Corporation, a subsidiary of Graton & Knight. The new corporation will change its name and will be known as **Graton & Knight Company, Inc. David S. Williams,** president of IPC will direct operations at Graton & Knight until a new general manager is named by the new management.

The newly established **Los Angeles Division of Clark Controller Company** appointed **King D. Christopher** as general manager. Besides handling Los Angeles area sales, the new division will include engineering and manufacturing departments.

Depatie Fluid Power Company, a newly formed organization, will be manufacturers representatives in western Michigan for hydraulic and pneumatic components, and will operate from 18 Ridgewood, Kalamazoo, Michigan. F. A. Depatie was formerly sales engineer in Detroit for the Rubber Products Division of Parker

Appliance Company. The lines represented will include Parker synthetic rubber O-ring seals; S-P cylinders and power chucks; air valves by Numatics, Inc. of Milford, Michigan; and drill heads by Hy-Neu-Math of Milwaukee and House Engineering of Montpelier, Ohio.

Greer Hydraulics, Inc. has made the following appointments. **Cecil Barlow** to manufacturing superintendent. He served previously with Greer Marine Corp. **Melvin Schoenberg** to planning supervisor. He has been with the company for ten years, holding

Cecil Barlow
Greer Hydraulics, Inc.

Melvin Schoenberg
Greer Hydraulics, Inc.

positions as chief project engineer and adminstrative engineer. **T. Lawrence Cronin** to director of industrial relations and **Robert P. Vartan** as controller of the company.

To increase production capacity by 30 percent, **Stillman Rubber Co.** has completed construction of a new warehouse and office building alongside their existing plant.

Continued on next page

NUGENT

LUBRICATING SPECIALTIES

LET YOU

SEE WHAT'S GOING ON!

- **SIGHT FEED VALVES** provide a means of regulating and visually checking oil flow at the point of delivery to bearings, gears, etc.
- **SIGHT FLOW INDICATORS** tell you at a glance, or by the sound of an alarm bell, whether or not oil is flowing properly to vital parts.
- **MULTIPLE OILERS** are furnished in a variety of types with any number of feeds and will materially reduce lubrication costs for machinery with many enclosed or hard-to-get-at bearings.

Nugent manufactures a complete line of lubricating specialties. Write for descriptive literature mentioning the type of equipment you are interested in.

NUGENT TRADE MARK

Established 1897

Wm. W. Nugent & Co., Inc.
3432 Cleveland St. Skokie, Illinois

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Representatives in Boston • Cincinnati • Detroit • Houston • La Junta, Colo. • Los Angeles Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

Circle 100 on Reader Service Card

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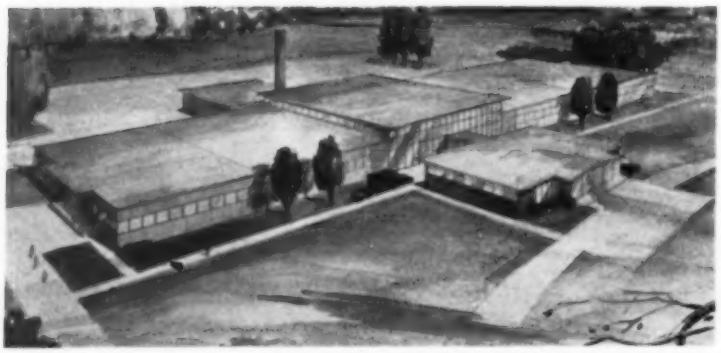
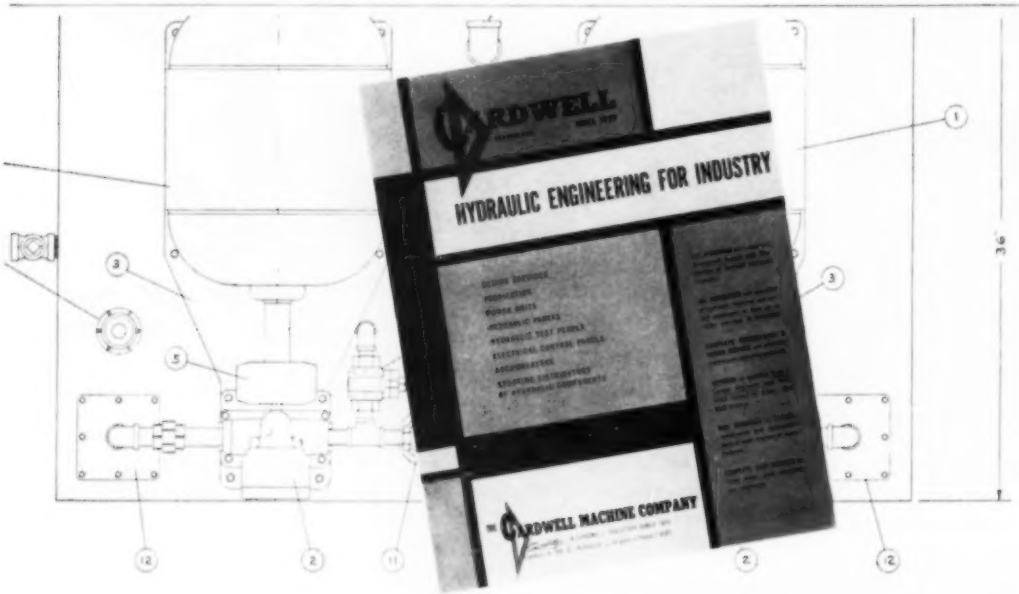


International Packings Corporation announced the start of a two-year expansion program for their plant in Bristol, New Hampshire. Located on a 70 acre site, the first building is expected to be ready later this year. Initial plans call for the erection of a highly specialized department which will manufacture custom-designed silicone and synthetic rubber products. The complete facilities, which are to be completed in successive stages, will include an administration building and laboratory and design engineering departments.

Bruce A. Drexel has joined the **R. P. Adams Company,** Inc. as sales engineer. He will work out of the home office at 225 East Park Drive, Buffalo, N. Y. Drexel was formerly with Will Process Equipment Corporation of Rochester, N. Y. as a sales engineer.

Induction Motors Corporation of Westbury, Long Island, N. Y., designers and manufacturers of sub-fractional horespower motors, has acquired **PSP Engineering & Manufacturing Co.** of Los Angeles, manufacturers of aircraft solenoids. The west coast firm will be known as the PSP Division, and will be operated as a wholly-owned subsidiary.

Anthony D. Zar has been appointed sales representative in charge of the Milwaukee district sales office of The **Babcock & Wilcox Company's** Tubular Products Division. His headquarters will be at 2430 S. 28th St.



Write for a copy of this new catalog which outlines the scope and flexibility of Cardwell services available to your industry.

The **CARDWELL MACHINE COMPANY**
Franklin at 19th St., Richmond 11, Virginia • Phone 7-4593
Several attractive territories still open for qualified Hydraulic representatives.

REVISIONS	THE CARDWELL MACHINE CO. RICHMOND, VA.		
	NEW CATALOG OF DESIGN AND FABRICATION SERVICES		
	DATE 8-21-56	DWN. BY H.L.W.	9269-1
	CHK. BY C.L.H.	SCALE 3/8" x 1'-0"	

These appointments were announced by **Vickers Incorporated: Robert Thoren** to district manager for the Rockford, Illinois, area. Thoren who joined Vickers in 1947 will be responsible

William B. Main
Vickers Incorporated

Robert Thoren
Vickers Incorporated

Charles W. Newman
Vickers Incorporated

for providing engineering assistance in northern and central Illinois and in central and southern Iowa. **Charles W. Newman** to manager of the Northwest branch. Headquartered in Seattle, the branch covers the northwestern United States. **William B. Main** to aircraft service manager—western region with offices at the El Segundo plant. **E. L. Burkhart** to personnel director.

Opening of a Chicago district office has been announced by **Tube Reducing Corp.** This new office, located at 10336 South Western Avenue, will be supervised by **D. L. Watson.** Watson has been with the company since 1953 and served previously in the New York district and at the Wallington home office.

Angelo P. Gatto has been appointed director of export sales of the **Dollinger Corporation.** Gatto was previously associated with the General Motors Corp. **Harold D. Cupitt** has joined Dollinger as sales manager of the original equipment, air filter division. Prior to joining Dollinger he served with Air-Maze Corp.

Parker Appliance Company appointed **Rocket Components Company,** Denver, Colorado as

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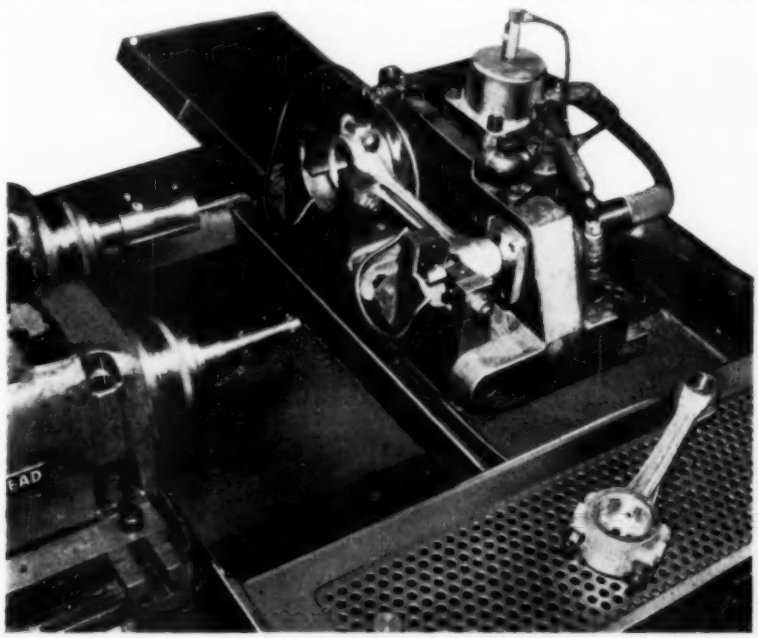


To cut machine time, consider the

FIXTURE FACTOR

For example — rough and finish boring of forged aluminum alloy connecting rods. This manufacturer designed a *fixture* that saves time. It works by Quincy compressed air. The operator flips a valve handle . . . the fixture snaps open or closed. Fixtures are changed easily for different size rods.

Often speeding up the fixture is the main way you *can* save time, when you're burdened with older equipment. You can also use Quincy compressed air to operate clutches and chucks . . . remove metal cuttings . . . operate hand tools, hoists and precision gages.

But be sure your compressor is a Quincy. Features like loadless starting and Safe-Q-Lube give you a steady supply of air years longer. 21 models from 1 to 90 c.f.m. Ask for Folder 300. Write today to Dept. A-1056.

Quincy COMPRESSORS

QUINCY COMPRESSOR CO. • QUINCY, ILLINOIS

Circle 110 on Reader Service Card

Post Scripts of Industry

continued

distributor for synthetic rubber O-rings. The firm, headed by **Paul Locklin,** services the Colorado area.

J. R. Matullo was recently appointed branch manager of the New Jersey Sales Office of the **Worthington Corporation.** He joined Worthington in 1934 as an application engineer in the Harrison Division Rotary Pump Sales Department, and Worked out of the New Jersey Office as a general line salesman since 1938. Matullo is a licensed Professional Engineer in the State of New Jersey, and a member of the Professional Engineers Society of Essex County.

Richard E. Tisch has been named manager of the new product development engineering department of **Minnesota Rubber & Gasket Company** in Minneapolis. The new department will conduct research, development and

Richard E. Tisch
Minnesota Rubber & Gasket Co.

testing operations on new products and will specialize in solving problems from customers. Tisch was formerly with Bendix Aviation Corporation's Pacific Division as senior test engineer and supervisor of the hydraulic and electromechanical engineering test laboratory.

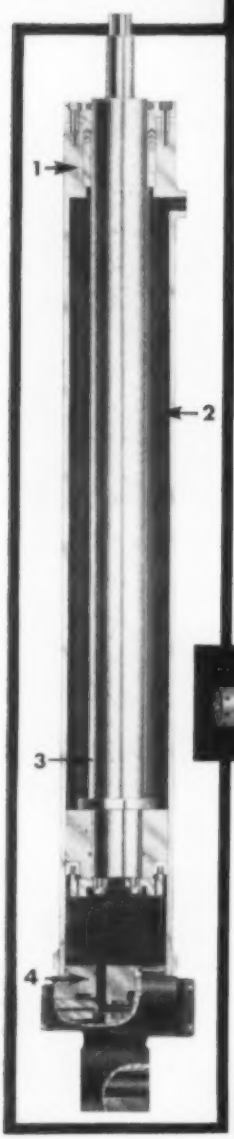
Elmer V. Mrozek, who previously served the northern Illinois area, will now cover the Wisconsin and Minnesota territory

Elmer V. Mrozek
Kalamazoo Division

for the **Kalamazoo Division of The New York Air Brake Company.** Mrozek has had considerable training and experience in the fluid power field.

BHEW

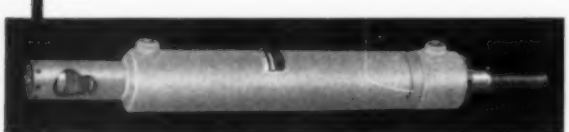
Custom-Built HYDRAULIC CYLINDERS



Made-to-order to meet specific design requirements for any application in any industry.

Compactness! Efficiency! Close Tolerances! Outstanding operational performance! You get them all in BHEW cylinders. They require minimum mounting space. There is no tooling charge for BHEW cylinders, built to *your* specifications and delivered on schedule.

BHEW cylinders are available in standard and special O.E.M. designs . . . single or double acting and telescopic; 1½" to 8" bore; strokes up to 156"; oil hydraulic service in 1,500 psi or 3,000 psi working pressure, pneumatic up to 150 psi; cup-type, ring-type or O-ring construction; choice of mounting.



1 Cylinder barrel and non-adjustable gland welded into one piece, eliminates joint, makes small O.D. in large single and double-acting hoist cylinders.

2 Accurately honed barrel.

3 Hard chrome-plated rod.

4 Flow regulating or pilot operative check valve in base, when required.

Send us specifications of your requirements, for full information.

Got a design problem involving cylinders? Our extensive engineering service is available to you without charge.

BHEW Benton Harbor Engineering Works, Inc.
622 Langley Avenue, St. Joseph, Michigan

Numatics, Inc., has promoted **Charles Stirling** to Detroit district sales manager. Prior to this assignment, Stirling was a Detroit sales engineer for the company.

Charles Stirling
Numatics, Inc.

George M. Pearse & Company, Newark, N.J. has been appointed as a distributor for **Fluid Controls, Inc. Robert G. Pearse,** president of the Newark firm, who will direct all the sales

Robert G. Pearse
George M. Pearse & Co.

activities of Fluid Controls products, has had more than 15 years experience in the hydraulic industry. The company will cover the nothern New Jersey, New York City and Long Island areas and will exclusively cover the metropolitan New York and New Jersey areas.

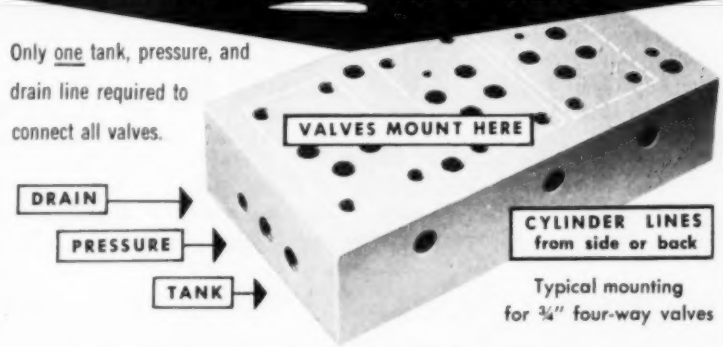
Wyle Manufacturing Corp., El Segundo, Calif. has been granted an exclusive manufacturing and sales license to use a new electro-hydraulic power amplification principle developed by Northrop Aircraft Inc.

Continued on next page

Circle 28 on Reader Service Card

*Standard DRILLED MANIFOLDS
OF SOLID GROUND STEEL NOW in stock!

Only one tank, pressure, and drain line required to connect all valves.



Typical mounting for ¾" four-way valves

In many cases you may select a *standard stock manifold, to fit your specific requirements at much lower cost. We also manufacture to your specifications or design special manifolds to fit your needs, either hydraulic or pneumatic. DRILLED MANIFOLDS of solid ground STEEL offer these important advantages:

• BETTER APPEARANCE • COMPLETELY LEAK FREE • MORE COMPACT
• LOWER COST • VALVES MAY BE REMOVED WITHOUT DISTURBING PIPING

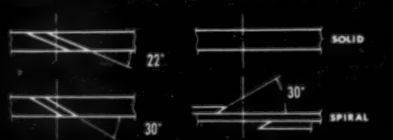
Reps. in all major cities

BIRMINGHAM Hydraulic Products

14540 SCHAEFER RD. DETROIT

Send for Catalogue

SHAMBAN KELON BACK-UP RINGS PROTECT O-RINGS IN ADVERSE CHEMICAL OR PHYSICAL ENVIRONMENTS



Write for Catalog

SHAMBAN KELON ENGINEERING CO.
11617 West Jefferson Blvd., Culver City, Calif.

Post Scripts of Industry

continued

George Ullring has been named assistant sales manager of the Allen Manufacturing Co. Ullring has been Allen's sales representative in the Cleveland and Pittsburgh area for 20 years. In his new capacity he will have charge of the company's field sales force. Succeeding Ullring in the northern Ohio territory is **Quentin H. Gessner** and **Harold M. Hattman** will represent Allen in western Pennsylvania. **Nicholas T. Annelli** was appointed sales office manager and **M. Raymond Whigham** was promoted to manager in charge of sales training and exhibits.

The S-P Manufacturing Corporation, has moved into their new plant in Solon, Ohio. The new facilities provide for all engineering and manufacturing operations as well as the executive offices.

THE MARKET PLACE

Classified Advertising Rates: Cost of Position Wanted Ad is $10.00 for the first inch, each additional line 90 cents. Cost of all other classified ads is $20.00 for the first inch and $15.00 for each additional inch or fraction thereof. Rates for Display Ads in this section will be sent on request.

REPRESENTATIVES WANTED

Haskel Engineering & Supply Co. of Glendale, California, Manufacturer of Hydraulic Test Stands, High Pressure Pneumatic Test Stands, Environmental Test Chambers, Pneumatic & Hydraulic Control Panels and Consoles, Hydraulic Power Units, Hydraulic Presses and Machinery, and High Pressure Gas Booster Compressors, has many excellent territories open for active qualified representatives.
We specialize in catering to the defense industry and would like representatives who are particularly active in that field in their territories.
Write, giving details, to R. L. Hayman, President, Haskel Engineering & Supply Co., 1236 S. Central Avenue, Glendale 4, California.

POCKET MANUAL OF ARC WELDING

For Welding Supervisors and Foremen:
Latest welding application data. Revised, pocket-size manual is a concise source of information for those responsible for maintenance and production welding operations.

For Operators and Inspectors:
An easy-to-read reference book that provides practical on-the-spot answers to many arc welding problems—172 pages of necessary working information that can be used in everyday shop work.

The Industrial Publishing Group
812 Huron Rd., Dept. AH
Cleveland 15, Ohio

Please send me —— copies of the POCKET MANUAL OF ARC WELDING at $1.00 each.

Check or money order is attached

NAME .....

ADDRESS .....

CITY AND STATE .....

DIRECTOR OF SALES WANTED BY HYDRAULIC CO.

- We are a young company recently formed by an established, reputable concern to consolidate all Hydraulic Controls Activity in a separate organization.
- We need a young, experienced sales executive to head our sales organization and complete the management team of Sales, Engineering, Manufacturing and Finance.

Our hydraulic products represent a growth potential of at least 50% annually, in the fields of construction equipment, agricultural implements, materials handling equipment, aircraft test stands, machine tools and electro-hydraulic controls.

Age range: 34-45 preferred.

Education: College graduate preferred.

Experience: Direct experience in marketing oil hydraulic equipment to original equipment manufacturers.

All replies held in strictest confidence. Please send detail resume to: Mr. T. F. Vogel

Dynex, Inc.
Affiliate of Blackhawk Mfg. Co.
1500 S. Muskego Avenue
Milwaukee 4, Wisconsin

WANTED
HYDRAULIC SALES ENGINEER

The Cardwell Machine Company, Richmond, Virginia, one of the major engineering and fabricating organizations in the South for hydraulic power units, hydraulic machinery, panels and consoles, requires young man for sales engineering job. Hydraulic background, not necessarily academic, sales correspondence experience, schematic circuit design are essential. Applicant will live in Richmond. This is a permanent position with good starting salary and excellent future in a company established for 129 years. Profit sharing, vacation, free life insurance and many other benefits. Write in confidence to E. M. Lipman, Vice President, The Cardwell Machine Company, P. O. Box 1359, Richmond, Virginia.

ENGINEER

Greatly diversified experience hydraulics, pneumatics. Proven success project supervision including component design—aircraft and industrial, complete systems for missile launchers, automatic machinery, and reactor controls, fuel metering controls, ordnance devices, etc. Interested top level position only. Write Box 10156 APPLIED HYDRAULICS.

DETROIT and CINCINNATI TERRITORIES

Representative wanted for special engineered
Air and Hydraulic Equipment
Complete Package Units
Special Cylinders—Valves—
Manifolds—Mechanisms
Should have existing standard lines with definite interest, background and engineering ability to handle special problems. Write Box 10256, APPLIED HYDRAULICS.

ENGINEERS WHO CAN RE-WRITE "THE BOOK"

Tough-nut pneumatics problems usually have no "book" solution. But some men begin where the "book" leaves off; re-writing or adding a "chapter" if that is necessary to solving the problem. Such men make up the engineering staff at Ross.
These positive-thinking men are creating "tomorrow's AIR-mation today" at Ross, and putting Ross valves in such demand that their ranks need expanding. Experienced engineers who would have their own resourcefulness rather than the "book" be their limit, are invited to join them.
For work in the home office staff, contact us at the below address. For field work, contact the Ross Representative nearest you.

Ross Operating Valve Co.
120 East Golden Gate
Detroit 3, Michigan

DEVELOPMENT ENGINEERS

OUR many development programs are among the most advanced in the country. At Honeywell Aero, prospects for even greater progress are very real

■ With many design teams working on a great variety of projects, we have exceptionally exciting opportunities to offer engineers capable of designing components and systems for—
INERTIAL GUIDANCE • DIGITAL COMPUTERS
FLIGHT CONTROL SYSTEMS • LIQUID MEASUREMENT SYSTEMS • VERTICAL AND RATE GYROS • STABILIZED PLATFORMS • INLET AREA CONTROLS • JET ENGINE CONTROLS

■ At Honeywell you'll head up your own task group. Draftsmen, technicians, model makers and evaluation engineers essential to the project will look to you for technical instructions.

■ An engineering degree or its equivalent plus practical experience with related or similar equipment is required.

CONSIDER THESE ADVANTAGES

■ Minneapolis, the city of lakes and parks, offers you metropolitan living in a suburban atmosphere. No commuting.

■ Your travel and family moving expenses paid.

■ Salaries, insurance-pension programs, plant and technical facilities are all first-rate.

■ Honeywell, leader in control systems, manufacturers of over 10,000 different products, offers unusual diversification and variety. A sound growth company, continually expanding, it offers permanent opportunity to you.

WRITE TO US

If you are interested in a career at Honeywell, call collect or send your résumé to Bruce Wood, Technical Director, Dept. T-8, Aeronautical Division, 1433 Stinson Boulevard, N.E., Minneapolis 13.

MINNEAPOLIS
Honeywell

AERONAUTICAL DIVISION

ELECTRO SNAP

ONE-WAY IMPULSE SWITCH

with exclusive advantages for automation

$10.50
plus $.25 shipping charge

Model ES4-KM2
½ actual size

ELIMINATES INTERLOCKING SWITCHES AND COMPLICATED ACTUATING DOGS

Ideal for pulsing solenoid valves on air-hydraulic controls, sequencing circuits, etc., because it allows other controls to reverse or operate the same circuit. Switch sends a short electrical impulse and then switches itself out of the circuit.

GIVES MORE DEPENDABLE CONTROL

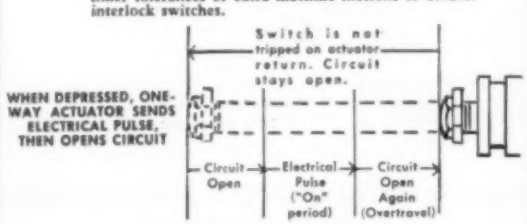
Switch replaces timers, relays, and troublesome one-way dogs to simplify circuits — cuts chances for failure. No delicate adjustments.

LOWERS COST OF CONTROL CIRCUITS

Impulse switch costs less than complicated control devices it replaces. Fewer switches are required for sequencing. Simple mounting.

SPEEDS UP AUTOMATIC OPERATION

Automatic machines can run faster because cycles can be more closely sequenced. There's no delay due to timer tolerances or extra machine motions to actuate interlock switches.


Switch is not tripped on actuator return. Circuit stays open.
WHEN DEPRESSED, ONE-WAY ACTUATOR SENDS ELECTRICAL PULSE, THEN OPENS CIRCUIT
Circuit Open
Electrical Pulse ("On" period)
Circuit Open Again (Overtravel)

SPECIFICATIONS

UL rated at 10 amps/125v AC Movement Dif. 0.020"
Operating Force 3½ lbs.

Model No.	Overtravel	"On" Period (inches of actuator travel)
ES4-KM1	3/8"	1/16"
ES4-KM2	5/16"	1/8"
ES4-KM3	1/4"	3/16"
ES4-KM6	1/16"	3/8"

TRY ON YOUR CONTROL JOB — ORDER NOW

Send Your Standard Purchase Order
Specify Model Wanted—Discounts on Quantity Purchases

ELECTRO SNAP

ELECTRO-SNAP SWITCH & MFG. COMPANY
4224 West Lake Street, Chicago 24, Illinois

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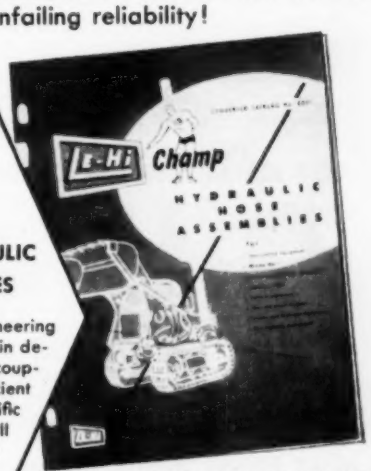

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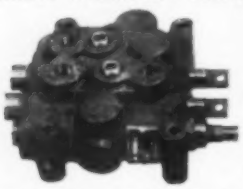

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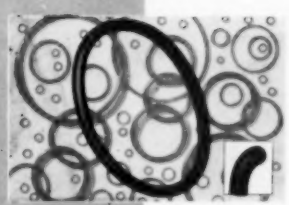

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